



# AERONAUTICAL ENGINEERING

A SPECIAL BIBLIOGRAPHY  
WITH INDEXES  
Supplement 45

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# AERONAUTICAL ENGINEERING

## A Special Bibliography

### Supplement 4 5

A selection of annotated references to unclassified reports and journal articles that were introduced into the NASA scientific and technical information system and announced in May 1974 in

- *Scientific and Technical Aerospace Reports (STAR)*
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# INTRODUCTION

Under the terms of an interagency agreement with the Federal Aviation Administration this publication has been prepared by the National Aeronautics and Space Administration for the joint use of both agencies and the scientific and technical community concerned with the field of aeronautical engineering. The first issue of this bibliography was published in September 1970 and the first supplement in January 1971. Since that time, monthly supplements have been issued.

This supplement to *Aeronautical Engineering—A Special Bibliography* (NASA SP-7037) lists 430 reports, journal articles, and other documents originally announced in May 1973 in *Scientific and Technical Aerospace Reports (STAR)* or in *International Aerospace Abstracts (IAA)*.

The coverage includes documents on the engineering and theoretical aspects of design, construction, evaluation, testing, operation, and performance of aircraft (including aircraft engines) and associated components, equipment, and systems. It also includes research and development in aerodynamics, aeronautics, and ground support equipment for aeronautical vehicles.

Each entry in the bibliography consists of a standard bibliographic citation accompanied in most cases by an abstract. The listing of the entries is arranged in two major sections, *IAA Entries* and *STAR Entries*, in that order. The citations, and abstracts when available, are reproduced exactly as they appeared originally in *IAA* or *STAR*, including the original accession numbers from the respective announcement journals. This procedure, which saves time and money, accounts for the slight variation in citation appearances.

Three indexes—subject, personal author, and contract number—are included.

An annual cumulative index will be published.

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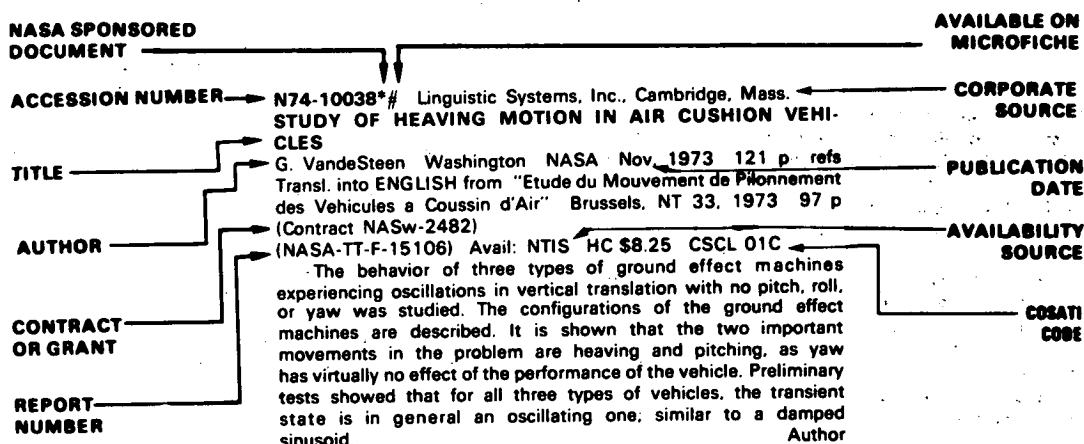
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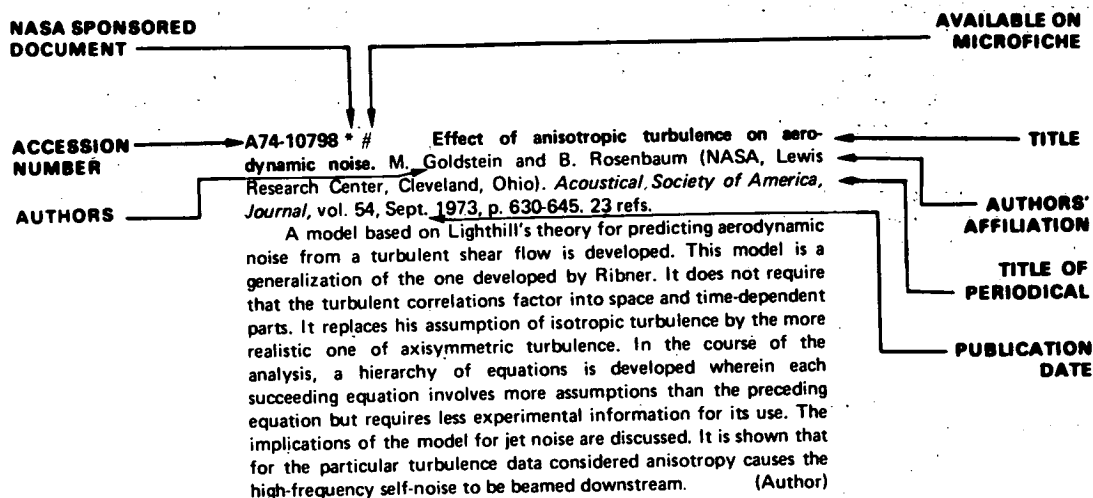
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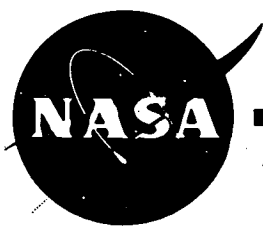
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# AERONAUTICAL ENGINEERING

*A Special Bibliography (Suppl. 45)*

JUNE 1974

## IAA ENTRIES

**A74-22451** Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Symposium supported by the American Helicopter Society. Philadelphia, Pa., Boeing Vertol Co., 1973. 673 p. Members, \$10.00; nonmembers, \$15.

Hingeless rotor vibration and loads at high advance ratios, model tests and analysis of prop/rotor dynamics for tilt rotor aircraft, and factors in the design and fabrication of powered V/STOL wind tunnel models, are among the topics covered in papers concerned with modeling and testing of V/STOL aircraft. Other topics covered include prediction of stability and control characteristics of rotor craft, an interdisciplinary approach to integrated rotor/body modeling, and ground-based helicopter simulation.

Individual items are announced in this issue.

M.V.E.

**A74-22452** Prediction of stability and control characteristics of rotorcraft. C. L. Livingston (Bell Helicopter Co., Fort Worth, Tex.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 17 p. 24 refs.

Description of a practical computer-based mathematical-model approach to the problem of predicting the stability and control characteristics of rotor aircraft, with special attention to the development of mathematical modeling for analyses of flying qualities. The predictive capabilities of a currently used mathematical model are described, particularly with respect to trim, stability, rotor dynamic response, and specific design requirements. Predicted and tested stability characteristics are compared. By means of several examples, the use of the mathematical model is illustrated. Future mathematical model development trends are reviewed.

M.V.E.

**A74-22453** An interdisciplinary approach to integrated rotor/body mathematical modeling. A. W. Kerr, A. J. Potthast, and W. D. Anderson (Lockheed-California Co., Burbank, Calif.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 13 p. 5 refs.

An interdisciplinary integrated rotor/body model has been developed to predict handling qualities, dynamic stability, performance and steady and transient loads for a single hingeless rotor aircraft throughout its entire flight envelope. The analysis method used may be applied to other rotor systems by minor modifications to the model. The approach employed in creating this model includes a coordinated effort between specialists in all applicable disciplines to provide an extensive analytical representation of a complete

rotary wing aircraft. The equations of motion are derived in Lagrangian form for 30 basic fully-coupled degrees of freedom with an absolute minimum of simplifying assumptions. The justification for the modeling approach taken is discussed in detail along with a description of the procedural ground rules required for successful implementation and use of this type model.

(Author)

**A74-22454** Ground based helicopter simulation. D. E. Cooper and J. J. Howlett (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 19 p.

Simulation difficulties unique to the helicopter arise because of its low speed and vertical flight capability. This paper addresses these difficulties, covering in particular the questions of how to keep the analytic sophistication within bounds, what to do about overall simulation response lags, how to provide adequate washout for best possible cues, and how to structure the overall simulation for the most satisfactory operation. With the development of an improved washout package, conversion of selected computations from digital equipment to analog equipment, improved actuator response, and the addition of lead networks, Sikorsky has obtained a satisfactory helicopter motion simulation and is now actively using this simulation in the development of all its new helicopters.

(Author)

**A74-22455** Rotor wakes - Key to performance prediction. A. J. Landgrebe and M. C. Cheney, Jr. (United Aircraft Research Laboratories, East Hartford, Conn.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 19 p. 95 refs.

Analytical and experimental techniques are described which define the geometry of the vortex field of hovering rotor and its effect on rotor performance. It is shown that the most important factor which influences the prediction of hover performance is the interference caused by the tip vortex during its first revolution. Integrated performance in forward flight is generally not sensitive to variable inflow. However, when combined with unsteady airfoil data, variable inflow can produce significant effects on blade torsional response. The history of helicopter performance prediction methods is briefly reviewed.

M.V.E.

**A74-22456** Aerodynamic problems in the calculation of helicopter airloads. W. Johnson (U.S. Army, Air Mobility Research and Development Laboratory, Moffett Field, Calif.) and M. P. Scully (MIT, Cambridge, Mass.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 31 p. 13 refs. Navy-sponsored research.

The contributions of recent developments in rotary wing aerodynamic theory, particularly lifting surface theory and distorted wake geometry, toward improving the calculation of helicopter airloads are assessed. The difficulties of airloads calculations

associated with the occurrence of dynamic stall are reviewed. Some problems involving both vortex induced loads and dynamic stall, and some related problems in blade motion calculation are discussed. It is concluded that there is a great deal of fundamental research remaining to be done into the phenomena involved in rotary wing aerodynamics. The aerodynamic problems still remaining in the calculation of airloads are discussed, and some suggestions are made of theoretical and experimental models which might be useful in future research into these problems. (Author)

#### A74-22457 The effects of Reynolds number on rotor stall.

W. G. S. Hardy (Boeing Co., Philadelphia, Pa.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 13 p.

Using an available mathematical model to relate fixed-wing knowledge of Reynolds number effects to rotary wing aircraft, the effects of Reynolds number on rotor stall are investigated. Reynolds number influences on rotor thrust are small in comparison to their effect on fixed wing lift, but these influences are more difficult to isolate in the case of rotary wings. There appears to be the necessity to break away from the fixed wing approach and consider not only lift effects on lift but also moment effects on lift. Aerodynamic pitching moment characteristics of the airfoil must be considered more critically, as well as the variation of these characteristics with Reynolds number, and the structural properties of the elastic blade. If this is done, meaningful predictions should become possible for each rotor under consideration and for the effects of Reynolds number on stall. M.V.E.

#### A74-22458 A review of aerodynamic and dynamic VSTOL

model testing. R. G. Loewy (Rochester, University, Rochester, N.Y.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 45 p. 25 refs.

Review of the art of aerodynamic and dynamic testing at reduced scales in support of V/STOL aircraft developments is shown to have made substantial progress in the last decade. The challenges that continue to call for the greatest skill include the inability to scale for Reynolds number, Mach number, and Froude number simultaneously, and the difficulties in making structural replicas at reduced scale. While the use of the NASA Freon tunnel can be helpful, the most likely solutions in the areas defined by the former challenge remain judicious isolation of the aerodynamic effects concerned. There is, however, justification for a greater effort toward application of boundary-layer triggers, magnetic supplementation of body-force fields, and the use of deformed models. M.V.E.

#### A74-22459 Factors in the design and fabrication of

powered dynamically similar V/STOL wind tunnel models. C. O. Albrecht (Boeing Co., Seattle, Wash.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 46 p. 7 refs.

Significant advances of the state of the art in modeling accomplished over the last four years are reviewed. Mach scaling of rotor systems down to the stationary swashplate support structure are shown to be completely feasible and practical. So are Froude-scaled full V/STOL models down to a 5-foot diameter. The feasibility of a Mach-scaled full V/STOL model is within grasp. Thinking about future V/STOL wind tunnel work is limited to no less than a Mach-scaled full V/STOL free flight model within the next 10 years. With this long range objective, important intermediate steps become somewhat easier to achieve. M.V.E.

#### A74-22460 Assessment of model testing of a tilt-prop-rotor VTOL aircraft.

R. L. Marr and G. T. Neal (Bell Helicopter Co., Fort

Worth, Tex.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 17 p. 9 refs.

This paper covers a wind-tunnel test program, underway since 1968, of one-fifth-scale models of the Bell Model 300. The paper discusses the objectives and results of aerodynamic and aeroelastic model tests, and describes the solutions devised for problems encountered during testing. It also illustrates the importance of including small-scale testing early in the development program of a new design. (Author)

#### A74-22461 Model tests and analysis of prop-rotor

dynamics for tilt-rotor aircraft. E. F. Baird, E. M. Bauer, and J. S. Kohn (Grumman Aerospace Corp., Bethpage, N.Y.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 16 p. 9 refs.

This paper presents some results of wind tunnel tests and analytical studies of a Grumman aircraft design called HELICAT which features a prop rotor mounted in a tilting pod at each wing tip. The rotor incorporates an offset flapping hinge with positive (pitch reducing) delta-three. The test program was divided between evaluation of the Helicat prototype design and investigation of a research whirl flutter configuration. Most of this paper is devoted to the whirl flutter investigation. One case of blade flutter was encountered in the Helicat configuration; 83 cases of whirl flutter were obtained in the research configuration. Forward, backward, and bimodal whirl flutter were encountered. The parametric study of whirl flutter included variations in blade pitch-flap coupling, hinge offset, rotor pod pitch and yaw stiffness, and damping. Analytical correlation studies showed good agreement with the test data. (Author)

#### A74-22462 A schlieren technique applied to rotor wake

studies. R. E. Walters and O. Skujins (West Virginia University, Morgantown, W. Va.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 34 p. 17 refs. Contract No. N00014-68-A-0512.

Experimental rotor wake studies are reviewed, along with their qualitative and quantitative results from flow visualization photographs, and the implications of these results for various rotor parameter correlations with such instability data as the growth rate of vortex filament waves and vortex-formed rotor wake boundary paths. Special attention is given to the effect of rotor blade mismatching upon the performance of the rotor system. A program initiated to study the effect of rotor blade tip modification upon the resulting trailing vortex and upon the performance of the rotor system is also discussed. M.V.E.

#### A74-22463 \* Hingeless rotor vibration and loads at high

advance ratio. G. A. Watts (Lockheed-California Co., Burbank, Calif.) and J. C. Biggers (NASA, Ames Research Center, Moffett Field, Calif.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 13 p. 6 refs. Army-supported research; Contract No. NAS2-5168.

Experimental values of mean and oscillatory shaft force aeroelastic derivatives with respect to cyclic pitch are presented in dimensionless coefficient form for stiff-bladed hingeless rotors operating at high advance ratio. Good agreement with theory is obtained for the 2P components, in rotating axes, of the oscillatory hub moment derivatives. Trends were predicted for the mean components. Experimental plots of the azimuthal distribution of blade flap bending moment due to cyclic pitch are compared with

theoretical for high values of flap frequency ratio and advance ratio. Good agreement is found near the blade root. The similarity parameters that should be preserved in the scale model testing of stiff-bladed hingeless rotors at high advance ratio are reviewed, and some aspects of hingeless rotor wind tunnel testing are considered.

(Author)

**A74-22464 \*** **Studies of a large-scale jet-flap rotor in the 40-by 80-foot-wind tunnel.** J. L. McCloud, III (NASA, Ames Research Center, Moffett Field, Calif.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 18 p.

Description of a large scale rotor and its apparatus which were constructed to investigate the merits of jet-flap applications to helicopter rotors. The presented results of a wind-tunnel study, aimed at determining the jet-flap multicyclic control potential for vibratory load and stress relief, illustrate the types of control deflections involved and their effects. A demonstrated analysis technique, which is used to analyze these results, is believed to be applicable to many kinds of investigations, particularly where large numbers of variables are involved and where circumstances tend to preclude 'systematic' testing. Among the major results of the study is the finding that significant and substantial vibratory stress and load reductions are achievable with a jet-flap multicyclic control system.

M.V.E.

**A74-22465** **Rotor aerodynamics and acoustics - The next phase.** J. P. Jones. In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 18 p.

Presented results of experimental studies on the time histories of banging and nonbanging helicopters, on tip vortex sequences, and on velocity distributions through tip vortices are reviewed in a discussion of rotor aerodynamics and acoustics. The effect of Mach number on the contribution of loading harmonics to fourth harmonic sound is considered along with the effects of shock waves from rotor blade tips.

M.V.E.

**A74-22466** **Acoustical modeling of the heavy lift helicopter.** H. Sternfeld, Jr. (Boeing Vertol Co., Philadelphia, Pa.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 19 p.

Description of the heavy lift helicopter (HLH) program which used wind tunnel modeling for acoustical design as an inherent part of the aircraft design development. The acoustic modeling work accomplished and the development of the techniques used are reported. The HLH, a tandem rotor helicopter, which weighs approximately 118,000 pounds and has two 90-ft diameter rotors, is primarily a logistical aircraft whose major tasks are associated with transporting large loads using an external sling. These operations often require that personnel on the ground work in close proximity to the hovering aircraft and place stringent limitations on external noise. This led to the development of the described techniques that made possible the use of a wind tunnel as an acoustical tool.

M.V.E.

**A74-22467** **An investigation of impulsive rotor noise using a model rotor.** J. W. Leverton and C. B. Amor (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 23 p. 8 refs. Research supported by the Ministry of Defence.

The investigation of gust induced impulsive rotor noise was made using a three-blade, 9-ft diameter model rotor. The gust was produced by a series of air-jets placed under the rotor disc, and the

noise characteristics were determined for a range of gust lengths and amplitudes. The main emphasis was placed on experimental measurements and theoretical prediction of discrete noise. The theoretical estimation of discrete noise was made using a simple point dipole theory and a more complex rotational noise theory. The theoretical results have been compared with measurements and show good agreement in both amplitude and characteristics over the full range of gust profiles used in the experimental programme. Broadband noise characteristics have also been reviewed in relation to possible blade stall.

(Author)

**A74-22468 \*** **A comparison of the noise characteristics of full scale and model helicopter rotors.** J. W. Leverton and J. S. Pollard (Westland Helicopters, Ltd., Yeovil, Somerset, England). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 31 p. 15 refs. Research supported by the Ministry of Defence and NASA.

Full scale and model rotor noise results are compared in terms of the spectral content, the directivity patterns, and the dependence on tip speed and rotor thrust/pitch angle. Each of the three main noise sources (rotational, low-frequency broadband, and high-frequency broadband) are reviewed separately, and account is taken of the measurement angle relative to the rotor disc. Blade 'scaling' effects are discussed together with the agreement between existing theoretical and semiempirical prediction methods. It is shown that in general good agreement is obtained between the full scale and model rotors for the spectral content and the velocity and thrust dependencies, while the 'scaling' factors associated with the low-frequency broadband noise do not seem to be appropriate.

(Author)

**A74-22469** **Parameterization of helicopter rotor broadband noise from experimental data.** H. K. Johnson (Rochester Applied Science Associates, Inc., Rochester, N.Y.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 47 p. 14 refs. Grant No. DAAJ02-71-C-0064.

A semiempirical relationship that represents helicopter broadband noise in terms of blade section parameters has been derived from measured whirl tower acoustic data generated at the Boeing whirl tower facility. These data made possible the successful development of a computer program that realistically predicts helicopter rotor noise. The computer program has the capability of evaluating the acoustic characteristics of new untested rotor designs as well as evaluating the effects of basic rotor design changes on the acoustic signature of existing rotors. One of the most important features of this program is that only a digital to analog conversion is required in order to evaluate the helicopter noise prediction subjectively.

M.V.E.

**A74-22470 \*** **Rotating-blade vortex noise.** J. Scheiman, W. Letko, J. P. Shivers, and D. A. Hilton (NASA, Langley Research Center, Hampton, Va.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 25 p. 8 refs.

An experimental investigation has been made of the Langley full-scale tunnel and outdoors to investigate some of the characteristics of vortex noise generated on a rotating-blade system. Acoustic measurements were made at several microphone positions for two different blade sections with several tip shapes and spoiler configurations. The blades were operated only at zero lift at each radial station, both for operating in their own wake and for operating with the wake blown downstream. Rotors with cylindrical blades generally created more noise throughout the noise spectrum than the rotor



**A74-22471** Experimental studies of rotational noise in forward flight. S. Widnall, P. Bauer, and A. Lee (MIT, Cambridge, Mass.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 24 p. 25 refs. U.S. Department of Transportation Contract No. TSC-93; Grant No. DAHC04-69-C-0086.

A large open-jet wind tunnel operating within an anechoic chamber was used to obtain the acoustic signal from a model rotor in hover and in simulated forward flight. The acoustic signal was well above the background noise of the tunnel which had been specifically modified for aerodynamic noise studies. The acoustic data were processed by a signal averager that removed the rotor broadband noise, leaving only the repeated transient signal - i.e., the rotational noise. Details of both the broadband and repeated transient signal are presented and discussed. Impulsive noise was clearly visible in many of the transient signals, most likely due to blade-vortex interaction.

(Author)

**A74-22472 \*** The role of wind tunnel testing in the development of advanced rotary-wing aircraft. M. W. Kelly (NASA, Ames Research Center, Large Scale Aerodynamics Branch, Moffett Field, Calif.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 18 p.

The relations of wind tunnel test objectives to wind tunnel test requirements are reviewed in an assessment of the current role of wind tunnel testing in the development of advanced rotary-wing aircraft. Elements of typical development programs are examined, and a comparison of fixed wing and rotary wing aircraft programs is presented. Proposed new test facilities for fixed wing aircraft and typical aircraft program costs are discussed, along with the use of wind tunnels for tilt rotor research aircraft and the role of 40 x 80 ft wind tunnels in tilt rotor aircraft development. Some changes in current programs and methods are outlined for bringing about desired improvements.

M.V.E.

**A74-22473** Panel prepared comments for the AHS mid-east region symposium. F. D. Harris (Boeing Co., Seattle, Wash.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 8 p. 5 refs.

Low speed wind tunnel costs are discussed along with model costs in relation to model size. Aeroelasticity is shown to be as important as Reynolds number, and it is pointed out that flow breakdown will affect blade loads considerably more than performance.

M.V.E.

**A74-22474** Panel discussion on wind tunnel testing. E. Fradenburgh (United Aircraft Corp., Sikorsky Aircraft Div., Stratford, Conn.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 10 p.

Review of the advantages and disadvantages of various test techniques used in advanced rotor concept evaluations. The considered test varieties include flight tests, full scale tunnel tests, tests of dynamic scale models at full and at reduced tip speeds, and tests of aerodynamic scale models. It is shown that the cost effectiveness of tests is essentially a function of the relative pertinence of the selected tests to the test objectives. It is also pointed out that, though purely aerodynamic models can be useful, no conclusions should be made about new concepts before the dynamic problems have been explored, for it is the dynamics that make or break a rotor system.

M.V.E.

**A74-22475** Comments for panel discussion on full scale vs. reduced-scale wind tunnel testing of V/STOL aircraft. E. H. Flinn (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 4 p.

It is pointed out that present wind tunnel facilities and techniques cannot provide completely reliable aerodynamic data for V/STOL configurations at low speeds, and that the theories used to correct the wind-tunnel measurements are no more trustworthy than are the theories which the experimental data are supposed to verify. The recommendation of a concerted effort is therefore made for the accumulation and correlation of sufficient data from theory, wind tunnel tests, and flight tests in order to obtain the confidence required in the mathematical models and analytical methods used.

M.V.E.

**A74-22476** Comments on significant development areas for future V/STOL wind tunnel testing. E. R. Wood (Lockheed, California Co., Burbank, Calif.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 22 p. 9 refs.

Briefly described with examples are six areas related to both full-scale and reduced-scale testing where we can expect to see increased emphasis in wind tunnel test programs in the near future. These areas are: (1) improved data retrieval and analysis methods, (2) investigations of rotor-rotor and rotor-airfoil interference effects, (3) new emphasis on flow visualization, (4) new investigations in unsteady aerodynamics, (5) continued tests of rotors at high-advance ratios, and (6) extensive wind tunnel studies of rotor dynamic response.

(Author)

**A74-22477 \*** Some comments on V/STOL wind tunnel testing in the transition flight region. W. H. Rae, Jr. (Washington, University, Seattle, Wash.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 13 p. 18 refs. Grants No. DA-ARO(D)-31-124-G1144; No. NGR-48-002-035.

Flow breakdown and flow distortion are discussed as the two limitations to wind tunnel testing of V/STOL models at speeds within or near the transition region. It is shown that a very large wind tunnel would be most useful for research into basic aerodynamic phenomena associated with V/STOL aircraft. The large tunnel will not be able to meet the requirements of all the desired testing of V/STOL models, and smaller existing tunnels will continue to be used. There is need for more work, both experimental and theoretical, to bring about a more correct use of the smaller wind tunnels. The large tunnel would be a most useful tool in this work.

M.V.E.

**A74-22478** Some special Navy V/STOL testing problems /as related to full scale simulation/. R. M. Williams (U.S. Naval Material Command, Ship Research and Development Center, Washington, D.C.). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 12 p.

Discussion of some of the V/STOL testing problems arising from the widening variety range contemplated for aircraft compatible naval ships which is to include surface effect ships that will expand the landing/takeoff platform speed to almost 100 knots. It is shown how the proposed new large-scale V/STOL facility could enhance operational capability beyond the classical and well documented uses.

of such a tunnel. Two subjects are used as examples: (1) the ship-aircraft interface, and (2) high advance ratio rotorcraft. The former would use the large area slow speed section of the proposed tunnel while the latter would use the smaller high-speed section. A tunnel speed capability of 300-400 knots is shown to be highly desirable for high-speed rotorcraft. M.V.E.

**A74-22479** Some noise requirements for large subsonic wind-tunnels. J. Williams (Royal Aircraft Establishment, Aerodynamics Dept., Farnborough, Hants., England). In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 10 p.

The need for wind-tunnel model experiments on aircraft noise and the difficulties of such experiments are discussed, along with such tunnel design considerations for noise experiments as those pertaining to the test section speed range, test section size and type, tunnel circuit type, and tunnel drive. It is shown that model-noise measurement requirements tend to increase somewhat the relative size of the wind tunnel, as compared with aerodynamic requirements. M.V.E.

**A74-22480** Comments on a theme - Full-scale versus small-scale wind tunnel testing of V/STOL. P. F. Yaggy. In: Status of testing and modeling techniques for V/STOL aircraft; Proceedings of the Mideast Region Symposium, Essington, Pa., October 26-28, 1972. Philadelphia, Pa., Boeing Vertol Co., 1973. 9 p.

The topic of full-scale vs small-scale wind tunnel testing of V/STOL aircraft is discussed with particular reference to rotary wing aircraft. It is shown that, in order to bring rotary wing aircraft to full realization of their promise, it is necessary to use judiciously small-scale and large-scale wind tunnel tests in conjunction with flight tests. Only thus is an adequate refinement of the required rotary wing technology base believed to be possible. M.V.E.

**A74-22501** Crack growth retardation under aircraft spectrum loads. M. Katcher (Rockwell International Corp., Anaheim, Calif.). (Symposium on Fracture and Fatigue, George Washington University, Washington, D.C., May 3-5, 1972.) *Engineering Fracture Mechanics*, vol. 5, Dec. 1973, p. 793-818. 17 refs.

The results are evaluated of fatigue crack growth test carried out with the compact tension specimen under aircraft spectrum loading to develop techniques for predicting fatigue life. Of the three tests run, one was HP-9Ni-4Co-0.30 C steel and two were diffusion-bonded Ti-6Al-4V alloys. The total damage due to crack growth is represented by a-N curves. Test data were compared with the predictions of the linear cumulative growth scheme and the Wheeler model, using constant amplitude crack growth rate data represented by the Forman equation as source data for the computer models. Both models seem to be suitable for comparison with actual test data for the samples and aircraft spectrum studied. However, additional tests performed with the 2219-T851 aluminum alloys showed the alloy to exhibit an accelerated behavior in relation to the linear cumulative growth scheme. An explanation is proposed by relating crack closure and spike overload studies in aluminum with the format of the applied spectrum. V.P.

**A74-22503** A review of some damage tolerance design approaches for aircraft structures. P. M. Toor (Lockheed-Georgia Co., Marietta, Ga.). (Symposium on Fracture and Fatigue, George Washington University, Washington, D.C., May 3-5, 1972.) *Engineering Fracture Mechanics*, vol. 5, Dec. 1973, p. 837-880. 84 refs.

The properties of available methods for residual strength analysis in aircraft structures are assessed with attention to their limitations. Various linear and nonlinear crack propagation laws and

loading effects in crack propagation are discussed. Fracture mechanics methods are applied to several types of structural components under spectrum-loading conditions. A comparison of test and analysis data for complex structures under loads indicated that simple methods of fracture mechanics should be effective in determining the damage tolerance strength and crack growth rates in aircraft components. More studies of the effectiveness of fracture mechanics methods on full-scale structural testpieces are urged to support positive laboratory evaluations of such methods. V.Z.

**A74-22519** Quasi-visual flight navigation (Flugführung mit Quasi-Sichtflug). E. Link. *Nachrichtentechnische Zeitschrift*, vol. 27, Feb. 1974, p. K18-K20. In German.

The concept of quasi-visual flight is introduced as an all-weather aircraft navigation system which is safer and more automatic than existing instrument flying methods. An interferometric sensor located in the aircraft receives 1-5 GHz radio beacon signals, and the incoming signal paths are then projected onto a screen in the instrument panel. The beacons are regularly distributed on the ground below usual flight paths, forming a beacon landscape. The aircraft themselves would transmit at another frequency as part of a collision protection system. P.T.H.

**A74-22522** # Biodegradation of materials used in the construction of utilitarian aircraft (Biodeteriorarea unor materiale folosite la constructia avioanelor utilitare). I. Pitis, N. Georgescu Buruntia (Institutul de Cercetari si Proiectari pentru Industria Electrotehnica, Bucharest, Rumania), and C. Stilpeanu (Academia Romana, Institutul de Mecanica Fluidelor si Cercetari Aerospatiale, Bucharest, Rumania). *Transporturi Auto, Navale si Aeriene*, vol. 3 (20), Nov. 1973, p. 594-599. 13 refs. In Rumanian.

Detailed review of the materials and methods used to guard against biodegradation of those parts of an aircraft which are made of wood. After briefly noting the types of wood used in the construction of aircraft wings and tail units, and describing the primary objectives of both interior and exterior protective coatings of wooden components, a detailed account is given of the results of tests of certain systems of primary coatings, enamels, and lacquers with regard to their applicability as protective agents against such biodegrading factors as high humidity and fungus growth when applied on various types of substrates such as filter paper, birch plywood, and aviation cloth. Also discussed are the results of tropicalization tests and mycological tests of these same materials. A.B.K.

**A74-22526** Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Seminar sponsored by SPIE, U.S. Air Force, and SMPTE. Edited by S. J. Rostocki (USAF, Avionics Laboratory, Wright-Patterson AFB, Ohio). Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers (SPIE Proceedings, Volume 36), 1973. 212 p. Members, \$17.; nonmembers, \$27.

Laser video recording on metallic thin film is discussed. Other papers are devoted to requirements and utilization of video tape recording and video film recording. Special video recording topics treated include a KDI image test and evaluation system, electronic measurement procedures for laser recorders, recorder video processing for image enhancement, a truly airworthy video disk recorder/reproducer, optical coatings to position laser scans, and an airborne real-time multispectral video processor. F.R.L.

**A74-22528** What we do and what we need. J. D. Taylor (USAF, Eglin AFB, Fla.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 31-36.

For better understanding of the full range of video tape recording requirements, three broad categories have been selected: aircraft installation, airborne weapons, and external pod instrumentation. Also included in the discussion are those logistic and technical problems created by deficiencies and incompatibilities in present-day equipments and their various applications. Some typical video tape recorder applications are investigated. Logical instrumentation requirements are finer definition of pictures, indicators, and scopes, and normal or narrow pulse width radar signals. F.R.L.

**A74-22529** The status of the F-14A airborne mission recorder requirements and utilization. D. A. Naurath (U.S. Navy, Naval Missile Center, Point Mugu, Calif.) and E. A. Schmidt (U.S. Navy, Pacific Missile Range Command, Point Mugu, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 37-42.

A study was conducted to investigate the F-14A mission recording requirements, the operation of similar recorders in the Fleet, and new types of 'off-the-shelf' recorders, which might meet F-14A requirements. Background information, recorder utilization in the Fleet, F-14A airborne recording requirements, and potential recording techniques that might meet these requirements are discussed. Video methods appear to offer the best means of recording and playing back the required multiple displays if a single synchronized recorder system is to be used. F.R.L.

**A74-22530** Commercial quality video recorders for airborne military applications. W. L. Curtice, III (USAF, Aeronautical Systems Div., Wright-Patterson AFB, Ohio). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 43-47.

The impact of new economic policies as applied to development and acquisition of a video tape recorder (VTR) for an airborne recording system to be used as an instructional aid for training in the T-37B aircraft is discussed. Requirements for a low cost recording system for nonmission-essential tasks can be met through the use of mass produced commercially available hardware. Such commercial hardware, if properly designed, can fulfill most environmental requirements of the Undergraduate Pilot Training/Audio Video Recording System (UPT/AVRS) system without modifications. However, extensive compromise of traditional military specification requirements in areas of maintainability, reliability, and environmental performance are both necessary and acceptable for a cost effective system of this type. F.R.L.

**A74-22531** Gunship video recording system - First high-quality battle damage assessment capability. R. S. Bradford (3 M Co., Camarillo, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 49-51.

Each aircraft carries a video tape recorder on which the sensor imagery, aircraft intercom channel, and a gunfire signal are recorded. Each mission consumes three to four tapes for a recorded time of up to two hours. These tapes are delivered to the Battle Damage Assessment (BDA) facility when the aircraft returns. Numerous quality control procedures and supervisory tasks have been established to ensure the desired high quality BDA film. An attempt is made to trace the evolution of the postflight information-processing system as it grew to meet the ever-increasing demand for a higher and higher quality film product. F.R.L.

**A74-22532** Flight tests of gated, low-light-level television for search and rescue. W. J. Engbrecht (U.S. Navy, Naval Missile Center, Point Mugu, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 53-61.

A flight evaluation of a gated LLLTV (low-light-level television) system for SAR (search and rescue) was conducted, the primary purpose of which was to ascertain the effectiveness of the LLLTV system in acquiring targets (radiating targets, cooperative or non-cooperative targets) at night on the ocean surface with the system operating in the passive or active (laser illumination of the target) modes. The second purpose was to compare standard light-signalling devices with a chemiluminescent device (Chemlite) as targets for LLLTV, and to compare their visual (optically unaided) acquisition distances. The third purpose was to determine whether or not the standard Navy sea dye marker, excited by a nitrogen-gas pulsed laser, would provide a visible light source with sufficient illumination to (1) serve as a visual reference for helicopter night hover, (2) enhance the ability of the searchers to locate a survivor, and (3) be readily acquired by LLLTV. F.R.L.

**A74-22533** A basic, highly maintainable airborne video tape recorder/reproducer. P. F. Muraco (RCA, Camden, N.J.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 65-70.

An example of a highly maintainable airborne video tape recorder/reproducer is the AN/USH-17(V), which can be described as a high performance, dual channel (wide-band), severe environmental, airborne video recorder/reproducer. The USH-17(V) is made up of three weapon replaceable assemblies (WRAs), a transport unit, an electronics unit, and a remote control unit. Applications for the USH-17(V) are bomb damage assessment in flight or at a later time, target recognition, reconnaissance/strike, high data rate digital recording, crew training, and general mission recording. F.R.L.

**A74-22534** Compact video tape recorders of exceptional performance and reliability. D. J. Cochran and A. R. Maxey (Echo Science Corp., Mountain View, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 71-75.

An attempt is made to provide a better understanding of rotary head video recorders in a relatively simple but comprehensive manner, and an approach to solving traditional problems common to these devices is given. The scanning format is the key to the performance of any rotary head tape recording device. The format governs the head-to-tape mechanical performance supporting all other parameters of the system. A hybrid format has been adopted which combines quadruplex performance and helical scan simplicity. F.R.L.

**A74-22535** A small high-performance videotape recorder for military airborne applications. D. B. MacLeod (Ampex Corp., Redwood City, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 77-84.

The Instavideo recorder was designed and developed as a rugged, portable video recorder for both color and monochrome. Recent tests suggest that the machine will operate well in airborne applications. Specifically, it offers low time-base error over wide ranges of temperature, vibration, and acceleration in all attitudes, uses 1/2-in. tape on a self-threading reel, can be supplied from



batteries or power, and weighs only 17.6 lb exclusive of power pack. Substantial advantages could be derived by separating the record unit from the playback system. The basic design and performance parameters which make the recorder particularly suited to airborne applications are reviewed. F.R.L.

**A74-22540** Development of teledyne video recording systems - Progression of state of the art in film recording. R. J. Deterville (Teledyne Camera Systems, Arcadia, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 117-120.

Approximately ten years ago it became obvious that a demand existed for a unique camera which would have the inherent capability of recording video information from a cathode ray tube. A development program was established with certain performance criteria considered to be mandatory. A primary characteristic was that no counterfeit image as a result of raster cropping either at the top or bottom could be tolerated. Additionally, no shutter bar nor mid-field splicing would be condoned. F.R.L.

**A74-22543** Pave Spike Video Film Recorder. C. D. Solheim (Perkin-Elmer Corp., Pomona, Calif.). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 143-147.

The Air Force initiated a request to photograph video displays in their Pave Spike system. Certain constraints were included in this request which dictated the following basic objectives in development of a video film recorder: (1) an optical design which would allow direct film recording of the video display without impairing the observer's view; (2) a mechanical design which would not interfere with the pilot's ejection envelope, would provide reasonably easy installation, and would allow loading and unloading of the magazine without removal of the camera; and an electronic design which would provide synchronization of camera operation in the 60 Hz field sync signal available from the video display equipment and automatic recording during laser firing. The results of evaluation tests provided specific guidelines for a final design, and this design is described. F.R.L.

**A74-22553** A truly airworthy video disc recorder/reproducer results in unique capabilities. P. Bartley and S. McWilliams (Arvin Systems, Inc., Dayton, Ohio). In: Military airborne video recording: Requirements, utilization and techniques; Proceedings of the Seminar, Dayton, Ohio, April 3-5, 1973. Redondo Beach, Calif., Society of Photo-optical Instrumentation Engineers, 1973, p. 201-216.

Discussion of the principle and technology of a disk recorder/reproducer system developed for the Air Force as a new airworthy technique of visual communications capable of stereoscopic vision, signal enhancement, and bomb or attack damage assessment. Design details are given on the dual disk system, the enhanced signal technique, the head/disk interface, the electronic equipment, and the stereoscopic base of the system. Also covered are a time base error study, idealized and practical head responses, the signal input servo system used, effectiveness evaluation techniques, and the human viewing process. V.Z.

**A74-22626** Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Seminar sponsored by the Flight Safety Foundation. Arlington, Va., Flight Safety Foundation, Inc., 1973. 207 p. \$10.00.

Collection of papers on various aspects of air safety, covering economics, medical examinations, pilot error statistics, incident analysis for accident prevention, automated radar terminal systems, and air transportation of hazardous materials. The topics also include aircraft wake turbulence, cockpit designs for improved coordination of crew operations, violations of safety principles in the cockpit, aircraft/runway interface problems, and safety aspects of microwave landing systems. V.Z.

**A74-22627** # Aircraft wake turbulence. J. F. Rudolph (FAA, Flight Standards Service, Washington, D.C.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 31-47.

Discussion of an FAA R&D program aimed at coping with current wake vortex problems which are significant in large transport aircraft. The program is planned to increase aircraft safety in terms of vortex hazard and allow a large increase in airport capacities by reducing the takeoff and landing spacing. The major points of the program include aircraft design modifications for wake vortex elimination, vortex dissipation methods, and automatic wake vortex avoidance systems. V.Z.

**A74-22628** # Recent development in aircraft safety air traffic control and navigation. C. G. Simpson (FAA, Systems Research and Development Service, Washington, D.C.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 48-58.

A review of recent developments in FAA E&D work in aircraft safety and air traffic control, covering aircraft airworthiness and crashworthiness, and the development of the Microwave Landing System for upgrading the U.S. air traffic control and navigation system. The important ingredients of this program are a collision avoidance system, a proximity warning indicator, and a discrete address beacon system. The program is expected to serve the needs of worldwide aviation for the next thirty years. V.Z.

**A74-22629** # Pilot error accidents in airline jet aircraft - 1958-1970. R. B. Stone (Lovelace Foundation for Medical Education and Research, Albuquerque, N. Mex.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 59-64.

Some 74 accidents were selected from a total of 200 accidents, after exclusion of taxi accidents, clear air accidents and near-miss accidents, in a computer analysis of common traits in U.S. airline jet pilot accidents over the period from 1958 to 1970. A breakdown of causes of the accidents is given, including 12 training accidents, 7 midair accidents, and other, 'off-profile flying', accidents comprising the rest. V.Z.

**A74-22631** # Cockpit design for crew coordination. H. Zeffert (British Aircraft Corp., Ltd., London, England). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 71-94.

Flight deck design features are evaluated including nose shape, pilot's position and vision, man-aircraft interface, flight deck layout, forward panels, lighting, and seats, in terms of crew coordination capabilities. Similar considerations are also given concerning the desirable control column, rudder pedal, pedestal, roof and circuit

breaker panels, and side console arrangements and designs. Other features include avionics equipment, flight engineer's station, hydraulics, pneumatics, and aircraft and engine controls. V.Z.

**A74-22632 # Flight safety work and the DFVLR.** F. Schatt (Deutsche Forschungs- und Versuchsanstalt für Luft- und Raumfahrt, Porz-Wahn, West Germany). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 95-111.

The organization and facilities of this German aerospace research center are briefly described in a review of work performed in its affiliated institutes, laboratories and test grounds. The review covers work in flight safety, aerospace medicine, flight control and guidance, propulsion systems, flight mechanics, aerodynamics, aircraft designs, atmosphere physics, avionics, and microwave technology. V.Z.

**A74-22633 # New orientations in the study of transport aircraft safety.** R. Chevalier (Société Nationale Industrielle Aérospatiale, Paris, France). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973. Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 112-119.

The progress in aircraft safety analysis techniques in the French aviation industry is discussed with particular reference to the Concorde and A 300 B aircraft. Some details are given on the safety systems adopted, covering airworthiness assessment, a classification of unsafe conditions, audio and visual warning systems, and computer applications in aircraft safety control. Emphasis is made on the necessity of increased safety standards with the advent of larger and more complex transport aircraft. V.Z.

**A74-22634 # Accident prevention by incident analysis.** A. W. Brunetti (Flying Tiger Line, Inc., Los Angeles, Calif.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 120-130, 5 refs.

Some recent aircraft accidents are analyzed to demonstrate that the failure to apply the available safety procedures rather than a lack of such procedures and capabilities has the major adverse effect on the efficiency of accident prevention efforts. Suggestions are made as to how this situation could be corrected when the various regulations and documents pertaining to aircraft safety were examined and adhered to with more coordination by airlines, manufacturers and regulatory agencies. V.Z.

**A74-22635 # Violations of system safety principles in the cockpit.** L. I. Davis (Lockheed Aircraft Corp., Burbank, Calif.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 131-140.

Aircraft accident statistics are given to indicate that in most cases a human error is the cause of accidents. A philosophy is set forth which traces this to the inherent human traits and suggests that the pilots be helped instead of being blamed for their errors. A procedure developed by Bell Labs for telephone switching circuit reliability analysis and adapted to weapon system applications in the Minuteman program is proposed as a useful approach to coping with the human error problem. V.Z.

**A74-22636 # Problems with the aircraft/runway interface.** M. Volz (United Air Lines, Inc., Chicago, Ill.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 141-172.

Tire/runway interface problems are discussed, covering runway friction, approach and landing, and stopping and directional control. Airport surface wetness evaluation, relaying of wetness information to the pilot, icy runways, approach angle-touchdown point position relations, braking and skid correction techniques, and safety aspects are considered. V.Z.

**A74-22637 # Use of ARTS-III in aircraft accident investigation.** C. O. Miller and W. G. Laynor (National Transportation Safety Board, Bureau of Aviation Safety, Washington, D.C.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 173-183.

Data obtainable from Automated Radar Terminal System (ARTS-3) and similar equipment are discussed with particular attention to the uses of such data in aircraft accident investigations and in accident prevention. A positive assessment is given to the potential of automatic radar tracking systems in aircraft accident prevention and accident cause determination. V.Z.

**A74-22638 # Automation Radar Terminal System - ARTS III.** J. W. Baier (FAA, Terminal Systems Branch, Washington, D.C.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 184-188.

The operational capabilities of this modular, expandable, programmable automation system designed for use in larger-density terminal radar control facilities are discussed. The evolution of the ARTS III system from the previous systems is described. Further development of the system is expected to include the following capabilities: automatic fault detection and reconfiguration, conflict prediction and resolution, terminal airspace and runway utilization optimization, and integrated flight data and display subsystems for real-time flight plan exchanges between the different services involved in air traffic control. V.Z.

**A74-22639 # Impact of microwave landing system on safety.** J. M. Jones (Royal Aircraft Establishment, Farnborough, Hants., England). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 189-197.

The implications of the development of a Microwave Landing System on air traffic safety are projected into the late 1970's in terms of the operational requirements of the ICAO. The capabilities of MLS are visualized as a C-band operational range between 5,000 and 5,250 mHz, less stringent installation siting requirements, and a general improvement in approach and landing systems safety. V.Z.

**A74-22640 # Air transportation of hazardous materials.** A. C. Bensmiller (U.S. Department of Transportation, Transportation Safety Institute, Washington, D.C.). In: Economics of air safety and long-range safety research and development; Proceedings of the Twenty-sixth Annual International Air Safety Seminar, Lisbon, Portugal, November 4-7, 1973.

Arlington, Va., Flight Safety Foundation, Inc., 1973, p. 198-202.

Some statistics on air transportation of hazardous materials in the U.S. is given. The Hazardous Materials Regulations concerning the air transport of explosives, flammable solids, poisons, radioactive materials, and etiological agents with background information and classification systems are reviewed, with attention to restrictions.

V.Z.

**A74-22651 #** Modern tendencies for training in piloting without visibility and in radionavigation (Tendances modernes pour l'entraînement au pilotage sans visibilité et à la radionavigation). J. Baradat (Matériel Téléphonique, Boulogne-Billancourt, Hauts-de-Seine, France). *ONERA and Institut de Recherche d'Informatique et d'Automatique, International Seminar on Simulation and Space, Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, France, Sept. 10-14, 1973, Paper. 15 p.* In French.

Simulation trainers are described which make it possible to effect exercises in the following domains: instrument flying (utilization of an integrated instrumentation), procedures of waiting and instrument approaches, and procedures of radionavigation. Although the trainer is rather an apparatus for training in flight procedures than for piloting properly so called, it is necessary, so that the procedures can be correctly executed, that the values and variations of fundamental parameters (engines, attitude, climbing speed, altitude) should be reproduced in a coherent manner, particularly during the important phases of waiting, approach, landing, takeoff, and cruising. The trainer has a supplementary advantage if its performances are adjusted to best represent those of the aircraft which the student pilots will most probably fly.

F.R.L.

**A74-22659 #** Endurance tests on glasses of transport aircraft (Essais d'endurance sur glaces d'avion de transport). M. Financé (Délégation Ministérielle pour l'Armement, Paris; Toulouse, Centre d'Essais Aéronautique, Toulouse, France). *ONERA and Institut de Recherche d'Informatique et d'Automatique, International Seminar on Simulation and Space, Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, France, Sept. 10-14, 1973, Paper. 13 p.* In French.

The glass to be tested is made up by stacking of several sheets of tempered glass separated by thinner sheets of butyrol (organic body). In one of the junction planes a heating resistance is integrated and a temperature probe which constitutes the detector element of a system of regulation is included. This system is regulated in order to obtain a practically constant temperature in the junction plane considered. The parameters simulated were cabin temperature and pressure, temperature at the level of the heating network, outside temperature, and coefficient of heat transfer.

F.R.L.

**A74-22662 #** Contribution of computer simulation to the development of aeronautical equipment or systems (Contributions de la simulation sur calculatrice à la mise au point d'équipements ou systèmes aéronautiques). H. Gosme (Toulouse, Centre d'Essais Aéronautique, Toulouse, France). *ONERA and Institut de Recherche d'Informatique et d'Automatique, International Seminar on Simulation and Space, Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, France, Sept. 10-14, 1973, Paper. 30 p.* In French.

Demonstration of the use of a simulation procedure in the development of two particular onboard aircraft systems. The proposed procedure is distinguished by the fact that it eliminates empiricism by relying, on the one hand, on functional equations verified by experimental results and, on the other hand, on methods of simulation currently available at the present level of technology. It is shown how the procedure described was applied in the development of a self-regulating hydraulic pressure pump intended for the onboard hydraulic power system and in the development of a set of two turbojet air-intake valves intended for the air-conditioning system of the Concorde.

A.B.K.

**A74-22665 #** Coupled vibrations in turbomachines and gas-turbine engines (Vzaimosviazannyye kolebaniya v turbomashinakh i gazoturbinnnykh dvigateliakh). S. I. Bogomolov and A. M. Zhuravleva. Kharkov, Izdatel'stvo Vishcha Shkola, 1973. 180 p. 51 refs. In Russian.

Theoretical and experimental study of the simultaneous coupled vibrations arising in various components of steam and gas turbines and gas-turbine engines. The matrix equations for the vibrations of the main structural elements of a turbine rotor are derived. Studies are then made of flexural-torsional vibrations of the working blades, vibrations of unbladed disks and shells, flexural vibrations of bladed disks, vibrations of disks of drum-disk type rotors, the critical velocities of multiple-bearing rotors of drum-disk type, and the coupled vibrations of elements of turboprop engine rotors. Particular attention is devoted to simultaneous vibrations arising in rotor-housing and disk-shaft systems.

A.B.K.

**A74-22670 #** Restoration in the laboratory of the effects of kinetic heating on the structure of the Concorde aircraft (Restitution en laboratoire des effets de l'échauffement cinétique sur la structure de l'avion Concorde). M. Perrais (Délégation Ministérielle pour l'Armement, Paris; Toulouse, Centre d'Essais Aéronautique, Toulouse, France). *ONERA and Institut de Recherche d'Informatique et d'Automatique, International Seminar on Simulation and Space, Ecole Nationale Supérieure de l'Aéronautique et de l'Espace, Toulouse, France, Sept. 10-14, 1973, Paper. 17 p.* In French.

A system is described which was utilized for all the thermal tests on the Concorde airframe. Static tests were carried out on a fuselage cross section and the adjacent wing with 78 heating channels, and fatigue tests were carried out on another cross section (15,000 simulated flights with 36 heating channels). Static tests were carried out on the entire airframe. The results obtained on the thermal tests were compared with values encountered in flight. For simulated missions identical with prototype flights the agreements are very good in the zones with strong thermal stresses.

F.R.L.

**A74-22677** Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Meeting sponsored by the Radio Technical Commission for Aeronautics. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 221 p. \$6.00.

An evaluation of the upgraded third generation ATC system is considered, giving attention to the report of the air traffic control advisory committee, plans for intermittent positive control, VORTAC improvements, collision avoidance systems, and a universal data link. Other subjects explored are related to international views of the upgraded third generation system and microwave landing systems.

G.R.

**A74-22678 #** Plans for intermittent positive control improved beacon and other features of the upgraded third generation system. N. A. Blake (FAA, Office of Systems Engineering Management, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 68 p.

The FAA plans and programs for implementing the recommendations of the air traffic control advisory committee are discussed. It is intended to develop the present ground-based ATC system which uses the ATC radar beacon system to a system that will make use of increased levels of automation. The new system is called the upgraded third generation system. Attention is given to the advanced air traffic management system, the airborne CAS, the discrete address beacon system, ATC automation problems, central flow control automation, ground surveillance and control, and solutions regarding tracking wake vortices.

G.R.

**A74-22679 # Navigation improvements - To what end.** W. B. Cotton (International Air Line Pilots Association, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 7 p.

Details regarding the upgraded third generation ATC system design are discussed, giving particular attention to navigation and VORTAC improvements. The relationship between navigational accuracy and separation criteria is explored together with the stated objectives and requirements for improved accuracy in aircraft navigation, as found in the FAA's planning documents. In connection with improving navigational accuracy, it is hoped to reduce VOR airway width and to make possible area navigation routes. More flexible routings for noise abatement are to be provided in the terminal area. G.R.

**A74-22680 # Navigation in the upgraded, third generation system.** W. M. Russell (Air Transport Association of America, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 7 p.

The navigation portion of the ATCAC report covers microwave landing systems, instrument landing systems, VORTAC, area navigation, vertical separation, and systems for long distance navigation. Particular attention is given to a few areas of current concern, including the need for implementation of more ILSs at a reduced cost and at difficult sites, an additional safety precaution needed for 50 KHz VOR/LOC operation, and improved VOR accuracy needed for the future. G.R.

**A74-22681 # Criticism of FAA handling of collision avoidance systems.** B. M. Goldwater, Jr. (U.S. House of Representatives, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 6 p.

There has been an average of 34 civil aviation collisions with 69 fatalities per year in the United States. In addition, in 1968, there were reported 2230 near mid-air collisions. The FAA is apparently opposed to an independent airborne collision avoidance system. Alternative approaches considered by the FAA are examined, giving attention to SYNCHRO-DABS. The qualifications of a proximity warning device are evaluated. G.R.

**A74-22682 # Collision avoidance systems.** D. R. Israel (FAA, Office of Systems Engineering Management, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 20 p.

A collision avoidance system (CAS) provides the pilot with a warning regarding other aircraft with which his aircraft is on a potential collision course. The CAS will also indicate an appropriate avoidance maneuver. A proximity warning indicator (PWI) warns the pilot that other aircraft are in the vicinity of his aircraft. A PWI may also provide the pilot with information concerning the relative position of the other aircraft. The positions which the principal users of the air traffic control system have taken with respect to collision avoidance systems are discussed. G.R.

**A74-22683 # The discrete address beacon system - Development, transition, and introduction.** M. T. Pozesky (FAA, Washington, D.C.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 12 p.

The discrete address beacon system (DABS) is being developed

both to improve the accuracy and reliability of the ATC surveillance system and to provide a digital air-ground data link for intermittent positive control and other ATC functions. Aspects of the motivation for DABS are discussed together with the DABS program, questions of the transition from the ATC radar beacon system to DABS, and air carrier considerations. G.R.

**A74-22684 # Air-ground communications in the upgraded third generation ATC system.** D. H. Featherstone (Aeronautical Radio, Inc., Annapolis, Md.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 6 p.

Digital communications requirements are considered, giving attention to the various air traffic control and support functions and air-ground communications not related to air traffic control or support. Questions concerning a universal data link capability are also explored. The solution of the air traffic control advisory committee integrates the ATC communications and surveillance functions into a single system. G.R.

**A74-22685 # International airline views on the United States' plans for the upgraded third generation system.** F. S. Tanner (British Overseas Airways Corp., London Airport, Hounslow, Middx., England). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 6 p.

The improvements to be obtained in connection with an introduction of the upgraded third generation system and their effect on the international airlines are examined. Attention is given to improved VOR/DME, the increased automation of the controller functions of conflict prediction and resolution, automatic intermediate positive control, the implementation of close-spaced, dual-lane runways, and the discrete address beacon system. G.R.

**A74-22686 # International user charges and their impact on world-wide implementation of ATC systems.** D. A. Lewis (International Air Transport Association, Montreal, Canada). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 6 p.

**A74-22687 # International user charges and their effect on the implementation of ATC, navigation, and communication systems.** R. R. Bohannon (Pan American World Airways, Inc., New York, N.Y.). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 6 p.

In the broadest sense the term 'user charges' includes landing fees, fuel taxes and charges, passenger charges paid by airlines, and en route charges. En route charges are the fastest growing of all and cover fees for en route navigation, communication, air traffic control, and meteorological, and search and rescue facilities and services. Aspects of the rapid escalation of the costs of the charges are discussed together with the reasons for this escalation and the effects of it. G.R.

**A74-22688 # The role of the International Civil Aviation Organization (ICAO) in obtaining international adoption and implementation of air traffic control, navigation and communications systems.** C. C. E. Bellringer (International Civil Aviation Organization, Montreal, Canada). In: Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973. Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 10 p.

**A74-22689 # Objectives for interim military landing systems:** J. W. Klotz (U.S. Department of Defense, Office of Director of Defense Research and Engineering, Washington, D.C.). In: *Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973.* Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 15 p.

It is pointed out that the NATO air forces have been pressing for interim standardization over the last four or five years. The NATO air forces engaged in a 'fly-off' of four available interim systems. The MADGE interferometer system was judged to be the winner of this competition. The MADGE is a ground-derived landing guidance system operating in the 5 GHz and 15 GHz bands. Attention is given to the U.S. Army's tactical landing system, the marine remote area approach and landing system, the standardization of antenna polarization, Air Force policy, plans of the Navy, and the Marine air traffic control and landing system. G.R.

**A74-22690 # FAA progress report on MLS Phase II.** J. W. Edwards (FAA, Washington, D.C.). In: *Upgrading the ATC system; Proceedings of the Annual Meeting, Washington, D.C., November 28, 29, 1973.* Washington, D.C., Radio Technical Commission for Aeronautics, 1973. 10 p.

The microwave landing system (MLS) development program is considered, giving attention to the feasibility demonstration phase of the MLS program. Questions of test program description and status are discussed together with the ICAO approach and landing system program and systems proposed by other countries, such as Australia, West Germany, France, and the United Kingdom. It is pointed out that the counsel provided by the aviation community has been most beneficial to the MLS program. G.R.

**A74-22785 # STOL aircraft with blown wings (Los aviones STOL de ala soplada).** J. L. López Ruiz (Escuela Técnica Superior de Ingenieros Aeronáuticos, Madrid, Spain). *Ingeniería Aeronáutica y Astronáutica*, vol. 25, Sept.-Oct. 1973, p. 33-40. In Spanish.

One of the simplest approaches for obtaining an aircraft with STOL characteristics makes use of the airflow which comes from the propeller and impinges upon the wing structure. This approach was first utilized in the French aircraft Breguet 940. In Spain the principles considered have been employed in the design of STOL aircraft in which a suitable aerodynamic wing form is combined with an appropriate motor control system to obtain short landing runs. The new design assures direct lift control without the use of spoilers or flaps. G.R.

**A74-22788 Quieting the JT3D powered 707.** J. F. Woodall (FAA, Washington, D.C.). *Sound and Vibration*, vol. 8, Feb. 1974, p. 20-25. 8 refs.

Flightweight, flightworthy acoustically-treated engine nacelles have been developed for the Boeing 707. The analytical techniques, predicted acoustics performance, ground test data, and flight test data confirmed that a retrofitted aircraft can comply with the noise requirements of FAR 36. (Author)

**A74-22789 Jet noise - The state-of-the-art.** G. Banerian (U.S. Department of Transportation, Washington, D.C.). *Sound and Vibration*, vol. 8, Feb. 1974, p. 30-34. 8 refs.

The theoretical basis for investigating jet aircraft noise has been Lighthill's equation derived from continuity and momentum. Various reductions of the formula are demonstrated when it is assumed that jet temperature equals ambient air temperature, that jet velocity components have a mean and fluctuating part, or that shear flow is parallel. Complications arise due to the fact that the sound source is moving, entailing modifications for self-noise and shear noise. The refraction of sound in the jet is discussed, accounting for the frequency spectrum associated with it. Various methods for

reduction of noise are examined, including rapid flow break-up or mixer nozzle systems in which a multielement nozzle is used to break up the flow and shift the noise generated in the jet wake to a higher frequency. P.T.H.

**A74-22803 # Simulation of the landing and take-off of a VTOL aircraft on a ship in a random sea.** G. H. Daffer and J. C. Gebhardt (CADCOR, Inc., Annapolis, Md.). *American Institute of Aeronautics and Astronautics and Society of Naval Architects and Marine Engineers, Advanced Marine Vehicles Conference, San Diego, Calif., Feb. 25-27, 1974, AIAA Paper 74-302.* 15 p. 13 refs. Members, \$1.50; nonmembers, \$2.00. Contract No. N00014-72-C-0531.

A mathematical model is described which is used to simulate the landing or take-off of a VTOL aircraft from the deck of a ship free to pitch, heave and roll. The motions of the ship are statistically related to those induced by a random sea. The aircraft model in the present simulation is a fixed control, non-steady state model but a mathematical description is given of a quasi-real time version where the aircraft model may be flown by the user in simulation time. The point mass force and moment equations of the aircraft, including the landing gear forces, are coupled and nonlinear. This simulation, as presently implemented on a time-shared digital computer, may be used to make rapid and realistic compatibility evaluations of ship-aircraft combinations. Results generated by a version of the model wherein motions are confined to the longitudinal plane are presented. (Author)

**A74-23076 # Investigation of the motion of a controlled body in a resisting medium under transient conditions (Issledovanie dvizheniya upravlyаемого tela, nakhodiaschegosia v soprotivliaiushcheisya srede, pri perekhodnom rezhime).** A. F. Embulaeva. *Leningradskii Universitet, Vestnik, Matematika, Mekhanika, Astronomiia*, Oct. 1973, p. 79-85. In Russian.

The transient regimes of a plant subjected to the action of controls are studied on the basis of a model that includes the plant itself and the controls. The analysis is based on a system of equations describing the small perturbations of longitudinal aircraft motion, in dimensionless form. Methods of the calculus of variations are employed. The individual transients obtained are used to determine the dynamic properties of the system. V.P.

**A74-23091 \* Aircraft symmetric flight optimization.** M. Falco (Grumman Aerospace Corp., Research Dept., Bethpage, N.Y.) and H. J. Kelley (Analytical Mechanics Associates, Inc., Jericho, N.Y.). In: *Control and dynamic systems.* New York, Academic Press, Inc., 1973, p. 89-129. 16 refs. Contracts No. AF 29(600)-2671; No. AF 49(638)-1207; No. NAS9-11532.

Review of the development of gradient techniques and their application to aircraft optimal performance computations in the vertical plane of flight. Results obtained using the method of gradients are presented for attitude- and throttle-control programs which extremize the fuel, range, and time performance indices subject to various trajectory and control constraints, including boundedness of engine throttle control. A penalty function treatment of state inequality constraints which generally appear in aircraft performance problems is outlined. Numerical results for maximum-range, minimum-fuel, and minimum-time climb paths for a hypothetical supersonic turbojet interceptor are presented and discussed. In addition, minimum-fuel climb paths subject to various levels of ground overpressure intensity constraint are indicated for a representative supersonic transport. A variant of the Gel'fand-Tsetlin 'method of ravines' is reviewed, and two possibilities for further development of continuous gradient processes are cited - namely, a projection version of conjugate gradients and a curvilinear search. A.B.K.

**A74-23104** Diffraction of evanescent waves, with applications to aerodynamically scattered sound and radiation from un baffled plates. K. L. Chandiramani (Bolt Beranek and Newman, Inc., Cambridge, Mass.). *Acoustical Society of America, Journal*, vol. 55, Jan. 1974, p. 19-29. 19 refs. Navy-supported research.

**A74-23105** Exhaust noise field generated in the JT8D core engine - noise floor presented by the internal noise sources. E. Grande (Wyle Laboratories, Inc., El Segundo, Calif.). *Acoustical Society of America, Journal*, vol. 55, Jan. 1974, p. 30-34. 9 refs.

An experimental study has been conducted to determine the strength of the acoustic radiation generated in the combustion and turbine stages of a JT8D core engine and transmitted out through the primary jet exhaust duct. The acoustic field within the tail pipe duct extension was measured by an array of microphones flush mounted on the extension wall. The interpretation of the cross-power spectral densities of the microphone signals by means of a theoretical model of the sound propagation within the duct permitted the acoustic energy transmission out of the nozzle exit to be determined. The results show that the internally generated noise is a dominant noise component from the core engine at larger angles from the jet axis for the case of low engine power settings. (Author)

**A74-23108** Fluctuating forces appropriate for the calculation of discrete frequency noise generation in subsonic turbomachines. S. Fleeter (General Motors Corp., Detroit Diesel Allison Div., Indianapolis, Ind.). *Acoustical Society of America, Journal*, vol. 55, Jan. 1974, p. 98-101. 9 refs.

Discrete frequency noise generation at blade-passage frequency and its harmonics is a result of the aerodynamic interaction between successive rotors and stators. These interactions result in fluctuating forces on the rotor and stator blades which are equivalent to dipole sources radiating sound. This paper describes the importance of including airfoil cascade parameters and compressibility, even at low Mach numbers, in calculations of these fluctuating forces. The results are based upon solutions to the unsteady, compressible, two-dimensional partial differential equation which describe the flow disturbances generated by upstream obstructions being convected downstream past an airfoil cascade. The parameters include the cascade stagger angle, cascade solidity, reduced frequency, and the ratio of the number of upstream obstructions to downstream airfoils. (Author)

**A74-23203 #** On the dynamics of human pilots in marginally controllable systems. N. Goto (Kyushu University, Fukuoka, Japan) and K. Washizu (Tokyo, University, Tokyo, Japan). *AIAA Journal*, vol. 12, Mar. 1974, p. 310-315. 11 refs.

In designing V/STOL and high-speed flight vehicles, knowledge of the human pilot's controllability limit may be needed. Measurement of the pilot's describing function for his control of the system with marginal levels of static stability or damping, or both, is important to determine the controllability limit. This report includes the results of describing function measurement for dynamically or statically unstable second-order systems. Also included is a brief explanation of an improved time domain analysis method. When the system is dynamically unstable, the results show that the pilot employs a modified describing function that contains a second-order lead term with a particular time constant associated with the undamped natural frequency of the system. For the statically unstable case, the results indicate that the pilot pays attention only to the unstable first-order mode so that his describing function coincides with that for the first-order unstable system control. (Author)

**A74-23205 #** A study of compressible potential and asymptotic viscous flows for corner region. K. N. Ghia and R. T. Davis (Cincinnati, University, Cincinnati, Ohio). *AIAA Journal*, vol. 12,

Mar. 1974, p. 355-359. 12 refs. Contracts No. F33615-72-C-1128; No. F33615-73-C-4014.

A new and direct approach for calculating the first higher order potential flow along an axial corner is presented. For the incompressible potential flow, the present approach demonstrates that the displacement effects in the corner may be visualized as the superposition of the displacement effects for the two intersecting semiinfinite plates forming the corner. The compressible subsonic potential flow is then obtained by the Prandtl-Glauert rule. Linearized airfoil theory is used to determine the potential flow for the supersonic case. The asymptotic viscous flow, to lowest order, for the corner problem has been calculated for general compressible flow. The analysis presented here recovers all the previously obtained lowest order asymptotic solutions. Cross flow velocity profiles have been given for freestream Mach numbers between 0.001 to 4 for an adiabatic wall as well as for a prescribed temperature at the wall. (Author)

**A74-23227 #** Lift and moment for arbitrary power-law upwash in oscillating subsonic unsteady thin-airfoil theory. N. H. Kemp (Avco Everett Research Laboratory, Inc., Everett, Mass.). *AIAA Journal*, vol. 12, Mar. 1974, p. 413-415. 5 refs.

The lift and moment for an arbitrary integer power-law upwash are derived by purely algebraic methods from results obtained for a general sinusoidal gust. The lift and moment for the upwash are given both for Osborne's (1973) approximate theory of oscillating thin airfoils in subsonic flow and for its incompressible limit. P.T.H.

**A74-23233 #** Determination of the aerodynamic characteristics of bodies of complex shape in a free-molecular flow with allowance for shading (K opredeleniiu aerodinamicheskikh kharakteristik tel slozhnoi formy v svobodnomolekuliarnom potoke s uchetchom zateneniia). V. P. Bass, V. M. Kovtunenko, and V. N. Chepurnoi. *Kosmicheskoe Issledovaniia*, vol. 12, Jan.-Feb. 1974, p. 40-44. In Russian.

**A74-23255** Advances in aerospace materials-processing technology. *Metal Progress*, vol. 105, Mar. 1974, p. 41, 42, 44 (13 ff.).

New steels and nickel-based alloys are discussed, along with aluminum, titanium, and copper alloys. Mechanical properties are graphically compared. An exposition of applications in aircraft structures and jet engines is given, and foreseeable future applications are discussed. The role of graphite-epoxy and boron aluminum composites and of other new fiber materials is sketched. Other topics include new methods in heat treating, cleaning and finishing, testing, forming, casting, welding and joining, powder metallurgy, safety, and ecology. P.T.H.

**A74-23327 \* #** Maximum likelihood identification of aircraft stability and control derivatives. R. K. Mehra (Harvard University, Cambridge, Mass.), D. E. Stepper, and J. S. Tyler (Systems Control, Inc., Palo Alto, Calif.). *Journal of Aircraft*, vol. 11, Feb. 1974, p. 81-89. 11 refs. Contracts No. NAS1-10700; No. N00019-69-C-0534.

Application of a generalized identification method to flight test data analysis. The method is based on the maximum likelihood (ML) criterion and includes output error and equation error methods as special cases. Both the linear and nonlinear models with and without process noise are considered. The flight test data from lateral maneuvers of HL-10 and M2/F3 lifting bodies are processed to determine the lateral stability and control derivatives, instrumentation accuracies, and biases. A comparison is made between the results of the output error method and the ML method for M2/F3 data containing gusts. It is shown that better fits to time histories are obtained by using the ML method. The nonlinear model considered corresponds to the longitudinal equations of the X-22 VTOL aircraft. The data are obtained from a computer simulation and contain both process and measurement noise. The applicability of the ML method to nonlinear models with both process and measurement noise is demonstrated. (Author)

**A74-23328 #** The cost of noise reduction in intercity commercial helicopters. H. B. Faulkner (MIT, Cambridge, Mass.). *Journal of Aircraft*, vol. 11, Feb. 1974, p. 89-95. 11 refs. U.S. Department of Transportation Contract No. TSC-93; Grant No. DAHC04.

The relationship between noise reduction and direct operating cost was studied for commercial helicopters having a design range of 400 miles. This was accomplished by generating a large number of helicopter preliminary designs with the aid of a computer program. Designs were selected to meet each of four noise level goals with minimum direct operating cost, establishing a curve of noise level vs direct operating cost. This was repeated for several payloads and technology time frames. It was concluded that good economic performance can be expected of relatively quiet future helicopters which have low tip speeds and high solidity rotors. With a 25% increase in direct operating costs the takeoff perceived noise level (PNL) at 500 ft for a 1975, 50-passenger helicopter can be kept below 80 dB PNL. The expected improvements in helicopter technology over the next fifteen years can offset the economic penalties due to noise reduction. (Author)

**A74-23329 #** A study of lifting rotor flapping response peak distribution in atmospheric turbulence. G. H. Gaonkar. *Journal of Aircraft*, vol. 11, Feb. 1974, p. 104-111. 20 refs.

Studies are made of the peak statistics of rigid-blade flapping responses to atmospheric turbulence at high advance ratios. The rotor model is characterized by a finite-dimensional linear system with periodically varying parameters and with feedback controls. System inputs represent a modulated nonstationary Gaussian process. The response description includes: (1) the ratio between the total number of peaks and of zero-level up-crossings per period, (2) the ranges of lower level thresholds within which the response process could deviate from being a narrow-band process, and (3) the accuracy of the approximate formulas of peak distribution conditional on the occurrence of a peak. The conditional probability density of peak magnitude indicates that high-level peaks which cause significant damage to system components are most likely to occur within narrow ranges of the azimuth angle. The Rayleigh density law provides a satisfactory approximation to this conditional probability density only within such narrow azimuth ranges. (Author)

**A74-23331 #** Transonic flow around symmetric aerofoils at zero incidence. D. Nixon. *Journal of Aircraft*, vol. 11, Feb. 1974, p. 122-124. 6 refs.

It is shown that the introduction of a simple correction factor, depending only on the transonic similarity parameter, improves the accuracy of the method of Spreiter and Alksne (1954). It is suggested that this correction factor is a universal function of the transonic similarity parameter which, once established, can be used in subsequent calculations. The correction factor is found by using the results of recent numerical methods (Murman and Cole, 1971; Murman, 1972) to locate the shock wave correctly in a number of examples. F.R.L.

**A74-23332 \* #** Extension of a vortex-lattice method to include the effects of leading-edge separation. D. T. Mook and S. A. Maddox (Virginia Polytechnic Institute and State University, Blacksburg, Va.). *Journal of Aircraft*, vol. 11, Feb. 1974, p. 127, 128. Grant No. NGR-47-004-090.

Vortex-lattice methods have been used successfully to obtain the aerodynamic coefficients of lifting surfaces without leading-edge separation. It is shown how an existing vortex-lattice method can be modified to include the effects of leading-edge separation. The modified version is then used to calculate the aerodynamic loads on a highly swept delta wing. The results are compared with Peckham's (1958) experimental data. F.R.L.

**A74-23353** The remote airport - A study of access feasibility. D. R. Miller, W. H. T. Holden (Daniel, Mann, Johnson, and Mendenhall, Los Angeles, Calif.), and T. K. Dellaway (Daniel, Mann, Johnson, and Mendenhall, San Francisco, Calif.). *ASCE, Transportation Engineering Journal*, vol. 100, Feb. 1974, p. 179-194. 11 refs.

An investigation is conducted concerning the access to an airport which serves a major metropolitan area, giving attention to differences in concept or approach that could be caused by the degree of remoteness of a particular airport. Relations between airport remoteness and traffic generation are discussed together with access modes to a remote airport and the required times of transportation. The possibilities of STOL service to the remote airport are explored, taking into account the amount of the passenger load which could be accommodated by that mode. The feasibility of providing rapid transit service to the remote airport is also investigated. G.R.

**A74-23376** Fluid power for aircraft: Modern hydraulic technology /2nd edition/. S. W. Merrill (Utah State University of Agriculture and Applied Science, Logan, Utah). Preston, Idaho, Intermountain Air Press, 1973. 286 p. 14 refs. \$9.00.

This book summarizes in a simple descriptive form the state of the art in aircraft applications of advanced hydraulic technology. The principles of hydraulic power generation, accident prevention and maintenance techniques, housekeeping practices, fluid supply in hydraulic units, direction and volume control, and hydraulic fluids are discussed. Hydraulic units, maintenance tools, plumbing operations, pressure-limiting, regulating and unloading devices, braking and landing gear systems, hydraulic system actuation, emergency pneudraulic systems, hydraulic testing, and support systems are described. Attention is given to the troubleshooting of a complete hydraulic system. A glossary of the terms used is appended. V.Z.

**A74-23392** American programs for reconnaissance vehicles and remotely piloted airplanes (Programmes américains d'engins de reconnaissance et d'avions pilotés à distance). *L'Aéronautique et l'Astronautique*, no. 43, 1973, p. 3-7. In French.

In their initial stage, pilotless planes flew along a programmed flight path or were guided by remote control. Most of them are now actually remotely piloted and are able in this way to perform a range of tasks wider than that of the sole reconnaissance missions. Following a brief review of the previous reconnaissance vehicle programs, the now current developments programs for pilotless airplanes designed for the reconnaissance, designation and attack of targets are detailed. (Author)

**A74-23393** Requirements and trends of collision avoidance systems (Nécessités et tendances en matière d'anticollision). J. Taillet (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*Congrès International Aéronautique*, 11th, Paris, France, May 23, 1973.) *L'Aéronautique et l'Astronautique*, no. 43, 1973, p. 9-19. 20 refs. In French.

Following a review of the objectives of anticollision systems in course of development, in the light of problems posed by their exploitation, definition is given to the imperative conditions which must be satisfied to pass to the operational stage. A certain number of criteria, bearing mainly on reliability, accuracy, price, and compatibility with ground control are formulated. The systems proposed by the principal constructors are briefly described and their principle of operation is analyzed. If in the actual state of the question it is not possible to formulate a value judgement susceptible of determining the choice of a better apparatus, it is however useful to attempt to classify the systems studied in the light of the criteria defined. F.R.L.

**A74-23396** Problems of quality of flight of future transport aircraft in course of development (Problèmes de qualité de vol des avions de transport de l'avenir en cours de développement). X.



Hafer (Darmstadt, Technische Hochschule, Darmstadt, West Germany). (*Journée Franco-Allemande Otto Lilienthal, 13th, Paris, France, Nov. 24, 1972*) *L'Aéronautique et l'Astronautique*, no. 43, 1973, p. 37-52. 25 refs. In French.

The present study describes the problems of flying qualities to be expected for future transport aircraft developments during the landing approach. The problems of stability and control for the longitudinal motion as well as the lateral motion are discussed. The first part of the paper deals with the effects due to an enlargement of mass of aircraft, taking typical subsonic and supersonic transport aircraft configurations into consideration. A brief discussion of possible influences of the elastic degrees of freedom yields that, for the aircraft enlargement considered, the assumption of a rigid aircraft seems to be justified. It is proved in the second part of the paper that the results of the influence of the mass enlargement can largely be transferred also to the case of a decrease in velocity. Accordingly, direct relations can be shown to exist between the mass factor and the velocity factor with regard to the various dynamic quantities.

(Author)

**A74-23398** The automatic approach of helicopters and STOL airplanes (L'approche automatique des hélicoptères et des avions ADAC). J.-C. Grisard. *L'Aéronautique et l'Astronautique*, no. 43, 1973, p. 59-64. In French.

Important efforts have been carried out to make the helicopter capable of flight without periods of prolonged visibility. A basic aspect of this effort concerns equipments of stabilization and automatic piloting. Attempts are described which have been made to define the equipments which are used, in production, on the SA 330, and SA 321 helicopters, and on the blind flying version of the Alouette III. A crucial aspect of blind flying remains: return to the landing ground under conditions peculiar to helicopters. Aspects of automatic approach or flight director approach are considered.

F.R.L.

**A74-23450** Distortions in aerial photographs due to internal refraction. V. M. Pozdniakov and Iu. S. Timofeev. (*Geodeziia i Aerofotos'emka*, no. 3, 1972, p. 85-93.) *Geodesy and Aerophotography*, no. 1-3, 1972, p. 169-173. Translation.

Assessment of the influence of temperature-and-pressure conditions in sealed aerial-photography compartments of aircraft. The influence is determined in terms of the magnitude of the aerial photograph distortions due to internal refraction. Procedures are considered for reducing and preventing these photograph distortions.

M.V.E.

**A74-23464** # Airline airplanes for the eighties - A response. J. Steiner (Boeing Commercial Airplane Co., Renton, Wash.). *Astronautics and Aeronautics*, vol. 12, Mar. 1974, p. 42-51.

Considerations of airline airplane selection for the 1980s are discussed in response to a recent British appraisal. It is pointed out that more system efficiency can be gained, and fuel saved, by solving the scheduled-vs-charter situation than by any other means, including airplane and engine design. The total commercial passenger-airplane market is expected to continue to require large, medium, and small aircraft in both short- and long-range applications.

M.V.E.

**A74-23517** # Adsorption resins in jet fuels (Adsorbtsionnye smoly v reaktivnykh toplivakh). B. A. Englin, M. P. Alekseeva, V. V. Sashevskii, S. M. Borisova, G. B. Skovorodin, and G. V. Kachurina (Vsesoiuznyi Nauchno-Issledovatel'skii Institut Neftianoi Promyshlennosti, Moscow, USSR). *Khimiia i Tekhnologiiia Topliv i Masel*, no. 2, 1974, p. 44-47. 6 refs. In Russian.

The composition, properties, and quantity of hetero-organic compounds isolated from straight-run and hydrorefined jet fuels by adsorption on aluminum oxide with subsequent desorption with methyl alcohol and acetic acid are determined for a variety of Soviet petroleum species. The tabulated data should be useful for studying the thermal stability and other performance characteristics of jet fuels.

V.F.

**A74-23518** # Additives for lubrication oils used with foreign gas-turbine aviation engines - Survey of patents (Prisadki k smazochnym maslam dlia zarubezhnykh aviatsionnykh gazo-turbinnykh dvigatelei - Obzor patentov). E. N. Kalatain and A. V. Vilenkin. *Khimiia i Tekhnologiiia Topliv i Masel*, no. 2, 1974, p. 60-63. 49 refs. In Russian.

**A74-23526** Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974. 171 p. \$10.00.

Crew and passenger survival in military and civilian transport aircraft under emergency conditions is examined in papers dealing with safety-related aircraft design aspects, personal protection gear, evacuation and recovery systems, and rescue aids. Attention is given to astronaut and military pilot helmets, crashworthy personnel seating systems in helicopters, flotation and survival equipment, explosive canopy severance, radio signaling equipment, aircraft accident investigation procedures, an antiblackout system, parachute performance evaluations, commercial aircraft evacuation on land and water, oxygen masks, and atmosphere purification.

T.M.

**A74-23528** Helmets and head protection in USAF ejections 1968-1972. C. A. Lehman (USAF, Directorate of Aerospace Safety, Norton AFB, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 12-16.

Helmet retention and head injury continue as significant problems in United States Air Force (USAF) ejections. This paper presents trends in the protection afforded by standard USAF and custom-built helmets from 1968 through 1972. The study includes an analysis of helmet loss versus airspeed, seat trajectory/stability, and helmet design. Ejection head injuries resulting from lack of protection or helmet loss are related to specific deficiencies in current helmets. The study shows that variations in aircraft design and mission require varying levels of protection as well as protection from different hazards. Specific hazards are addressed, such as noise, Q forces, deceleration, ballistic threats, buffet, windblast, acceleration, and impact. In conclusion, some guidelines for future development are provided.

(Author)

**A74-23529** U.S. Navy development of a mission specific fighter helmet. M. J. Lamb and D. N. DeSimone (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings.

Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 17-20.

The Naval Air Development Center is conducting a development program to provide a head protective system for use in the ACM (air combat maneuvers) environment of fighter type aircraft. Designs have been finalized on configurations for retrofit of present APH-6 series helmets and, the introduction of improvements for near-future procurements. In addition, the program continues development to include optimized design of completely new system configurations. This continuing development, operating within a two-year time frame, is 50% complete with first prototypes demonstrating lightweight low volume integration of component systems, resulting in a two-pound helmet assembly. The purpose of this paper is to present design conclusions and to indicate the direction of future developments.

(Author)

**A74-23531** Explosive canopy severance. F. B. Burkdoll and B. C. Asakawa (Explosive Technology, Inc., Fairfield, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings.

Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 27-29.

The possibilities of ejection through cast acrylic, stretched acrylic, or polycarbonate canopies were investigated. The size of the linear explosive charge needed to sever a canopy depends on the material and thickness of the canopy. Ejection through cast acrylic canopies of most thicknesses is entirely feasible; ejection through stretched acrylic canopies is feasible for a limited canopy thickness; ejection through polycarbonate canopies is not at all feasible. Zero-zero and 225 knot tests were conducted which utilized dummies. Of prime consideration are the trajectories of the major pieces of the broken canopies. P.T.H.

**A74-23532** An approach to the design of integrated life support systems for two new USAF aircraft. W. J. Hebenstreit and W. A. Berge (Boeing Aerospace Co., Seattle, Wash.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 30-34. 5 refs.

The objective of the study was to analyze, develop and design an integrated life support system for both an Advanced Tanker (CX) and the Medium STOL Transport (C-14) currently undergoing prototype development. A systematic analysis of all requirements led to the development of design concepts which were subjected to detailed trade studies. The final phase of the program addressed the design of the selected concepts, the preparation of extensive documentation, and the preparation of specifications for the systems. (Author)

**A74-23533** B-1 Crew Escape System. H. E. Sweet (Rockwell International Corp., Los Angeles, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 35-48.

The design configuration, simulation and analysis, and system test program for the B-1 Crew Escape System currently developed are described. At the heart of the system is the crew module concept that provides the 'shirt sleeve' environment of maximum crew comfort and physical freedom for the performance of mission tasks while affording escape and recovery of the crew by ejection of the module, if necessary. M.V.E.

**A74-23534** Crashworthy Army helicopter crew and troop seating systems. G. T. Singley, III (U.S. Army, Air Mobility Research and Development Laboratory, Fort Eustis, Va.), S. Desjardins (Ultrasystems, Inc., Dynamic Science Div., Phoenix, Ariz.), and M. J. Reilly (Boeing Vertol Co., Philadelphia, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 49-58. 18 refs.

The achievements of research and development in the area of occupant seating systems are the subject of this paper. The need for seating systems with improved strength, crash force attenuation, and occupant restraint characteristics is presented. Recent research and development efforts by the Eustis Directorate in the area of crashworthy seating systems are discussed, including the following: (1) forward-facing aircrew restraint system; (2) helicopter troop seat restraint system; (3) crashworthy armored helicopter pilot/co-pilot seat prototype; (4) crashworthy helicopter troop seat; and (5) crashworthy helicopter door gunner (side-facing) seat system. Analytical and testing results are reviewed. Promising designs and improved design criteria are also discussed. (Author)

**A74-23535** Underwater escape from helicopters. E. V. Rice and J. F. Greear, III (U.S. Navy, Naval Safety Center, Norfolk, Va.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 59, 60.

ment Association, 1974, p. 59, 60.

The majority of ditched helicopters sink immediately, rolling inverted, with water rushing in through cockpit windows. Inrushing water forces many occupants into the rear of the fuselage, and the resulting disorientation often prevents them from reaching escape hatches which cannot be seen in darkness. Others are strapped in their seats at the time, cannot release their lap belts, and drown. It is recommended that survival chances be enhanced by: (1) the installation of water-actuated linear shaped charges in bulkhead areas, around hatches and windows in the overhead and deck, and in the tail section; (2) installation of highly visible lighting material around all escape areas; (3) development of water actuated lap belt releases; and (4) implementation of realistic underwater egress training. (Author)

**A74-23536** Sea trials on inflatable flotation and survival gear. E. J. Colacicco (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 61-63.

Description of three inflatable survival gear sets, and review of the sea trial procedures used for the performance evaluation of the described equipment. The evaluated survival gear consists of: (1) a developmental Helo Survival System, (2) an Encapsulating Raft designed for fighter/attack aircrewmembers, and (3) a proposed Interim Survival System for the Harrier AV-8A Aircraft. M.V.E.

**A74-23538** Survival radio performance tests. H. C. Klein (U.S. Navy, Quality Evaluation and Engineering Laboratory, Oahu, Hawaii). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 69-73.

Between July 1972 and April 1973, a number of military survival radio range tests were conducted to investigate the effectiveness, range, antenna pattern of the radios, and the effect of half-wave versus quarter-wave antennas on the radios. The radios investigated were the tri-service AN/PRC-90, the Navy AN/PRC-63, and the Air Force AN/URC-64 survival transceivers transmitting on 243.0 Mhz. The tests were conducted off the island of Oahu with the transmitting radio in a life raft at sea and the receiving aircraft flying patterns to 20,000 feet. Transmitting ranges were 25 to 75 miles at various altitudes. Half-wave antennas were superior in range and signal strength to quarter-wave antennas. The squelch setting on the search aircraft receiver was generally mis-set and had a marked effect on the effectiveness of the survival radio. (Author)

**A74-23541** Helicopter safety. T. R. Stuelpnagel (Summa Corp., Hughes Helicopters Div., Washington, D.C.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 82-84.

The design feature of the Hughes Model 500C helicopter are discussed in terms of three levels of safety: design integrity, unpowered flight mode, and crashworthy structure. Design integrity consists of such items as safe load factors, selected load paths, redundant load structure, simplicity of design, derated engine power, and center of gravity control. In the unpowered flight mode, there is a wide range of safe speed/altitude operation yielding, for example, at 2000 ft altitude approximately 15 square miles of potential landing sites. The use of load absorption and roll bar structure contribute to a crashworthy structure. P.T.H.

**A74-23542** Peripheral vision - A factor for improved instrument design. A. H. Hasbrook (FAA, Civil Aeromedical Institute, Oklahoma City, Okla.). In: Survival and Flight Equipment Association, 1974, p. 85-86.

Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 85-87.

Certain limitations of central vision are discussed. Use of peripheral vision as a factor in the design of improved aircraft instruments is suggested as a means of providing the pilot with essential flight information without requiring constant use of central vision for scanning the instrument panel. Major design ingredients needed for utilization of peripheral vision are outlined, and a flight display containing these essential elements is described. (Author)

**A74-23543** Summary of fire and explosion manual for aircraft accident investigation. R. G. Clodfelter (USAF, Aero Propulsion Laboratory, Wright-Patterson AFB, Ohio) and J. M. Kuchta (U.S. Bureau of Mines, Mining and Safety Research Center, Pittsburgh, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 88-92. 6 refs.

This paper is a summary of a report, 'Fire and Explosion Manual for Aircraft Accident Investigators' (AFAPL-TR-73-74), prepared by the Bureau of Mines at the request of the Air Force to provide aircraft accident investigators with compilations of various safety data and with suitable guidelines for investigating aircraft fires or explosions. Sections are included on investigative procedures, physical properties of materials, ignitability and flammability characteristics of flammable fluids or solids, damage analysis of fires or explosions, and the evaluation of protective measures. Compilations of selected data for fuels, lubricants, hydraulic fluids, explosives, and other materials of interest are given in the appendix for quick reference. Definitions and theory necessary to the application of these data are included in the appropriate sections of the manual.

(Author)

**A74-23544** Advanced aircraft oxygen systems. F. W. Thompson, Jr. (USAF, Flight Dynamics Laboratory, Wright-Patterson AFB, Ohio) and A. J. Adduci (USAF, Life Support System Program Office, Wright-Patterson AFB, Ohio). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 93-97.

Advanced aircraft oxygen systems are being developed by the Air Force in order to achieve greater flexibility and cost effectiveness. Because they are self-sufficient, these new systems will eliminate the ground support resupply operation currently required after every flight usage. Three different chemical concepts for generation of oxygen inflight are presented: chemical reactors that reversibly absorb and then release oxygen, electrochemical separation of oxygen from air using solid electrolyte membranes, and solid chemical charges that decompose to produce a predetermined quantity of breathing oxygen. Various applications for each concept are discussed including oxygen systems for fighters, bombers, helicopters, and individual personnel units. In general, the paper provides an overview of several new oxygen systems covering both the technical and the application aspects. (Author)

**A74-23549** Integrated logistics support and acquisition management /ILS-AM/ panel for aviation-crew systems equipment changes. R. Gilles and J. Harding (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 110, 111.

The purpose of the ILS/AM panel is to coordinate the various logistic support aspects of implementing changes in certain survival, safety, and personal equipment used by Naval aircrews. It consists of representation from advisory, operational, and implementation

activities. The advisory portion is staffed in part by representatives from the Office of the Chief of Naval Operations and from the Naval Air Systems Command. P.T.H.

**A74-23550** Confined space atmosphere purification unit. W. L. Loudon (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 112-115.

The protective clothing and devices worn by aircrews in modern high performance aircraft severely limit comfort and efficiency. The aircrew module is being developed in an attempt to alleviate these limitations. The aircrew module environmental control system incorporates an atmosphere purification unit. This unit removes carbon dioxide and water vapor from exhaled gas by means of a selectively permeable membrane scrubber. Laboratory tests indicate this scrubber concept is feasible. A breadboard atmosphere purification unit incorporating this scrubber concept is under construction.

(Author)

**A74-23551** Anticipatory anti-blackout system. D. G. Naber (U.S. Naval Material Command, Naval Air Development Center, Warminster, Pa.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 116-118. 5 refs.

Two major difficulties are encountered with presently available 'G' valves used in antiblackout systems. Engine bleed air, the pressure source, contains contaminants which are deposited in critical areas of these valves. Slow response times leave the airmen momentarily unprotected at the onset of rapid accelerations. The system described in this paper continuously predicts the maximum 'G' to which the aircraft can be subjected at any instant. Above a predetermined minimum possible 'G', the protective garment bladders are inflated to just above ambient pressure. At the onset of 'G' any additional inflation provides immediate pressurization and thus protection. The pressure source is the clean breathing oxygen supply. (Author)

**A74-23552** A new approach to the design of quick release boxes for single point parachute harnesses. W. Karok (Autoflug GmbH, Hamburg, West Germany). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 119-126.

A discussion of the comparative merits of three-point release parachute harnesses and of single point release harnesses equipped with a quick release box. The continuous improvement and new aspects of design of single-point release harnesses are outlined. The most significant recent developments were the introduction of a positive lock rather than spring-loaded plungers to withstand shock loads, reduction of release pressure, shaping of the turning plate in order to keep dirt and foreign matter from jamming it, and incorporation of a new additional securing device against inadvertent opening. P.T.H.

**A74-23553** Paratroop harness TOTAL, PARAQUICK canopy release and EFA-36 chronobarometric parachute opener. M. H. Pravaz (Etudes de Fabrications Aéronautiques, Clichy, Hauts-de-Seine, France). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 127, 128.

The EFA type 36 chronobarometric handgrip combines automatic parachute opening and emergency manual control in a single system. The mechanism is locked by a ball. The TOTAL harness is of the completely open type. An elastomer handle constitutes the safety, but is also connected to the locking clip. The PARAQUICK canopy release features a cover part that cannot be closed if the release itself is not properly and safely adjusted. P.T.H.

**A74-23554** Emergency Evacuation and Survival Equipment Deployment for transport aircraft /EESED/. G. D. Klotz, R. D. Weiss, and F. B. Pollard (Teledyne McCormick Selph, Hollister, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 129, 130.

The EESED program demonstrated that survival techniques used in space capsules and military jet aircraft can be applied to civil and military transports. These techniques include (1) the creation of emergency exits by using a linear shaped charge to sever the airframe and (2) the automatic deployment of an F-2B 20-man life raft and a conventional aircraft escape slide. The system utilized components already developed and qualified for other aircraft and would therefore not impose a large development program on a potential user. P.T.H.

**A74-23555** Recovery system for an advanced performance ejection seat. H. R. Moy (Douglas Aircraft Co., Long Beach, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 131-136.

The primary parameter describing how well an escape system performs is the actual distance along the aircraft flight path, including lateral displacement, that the crewman travels from the time he initiates escape until his parachute is fully inflated. A reefed parachute exhibits lower opening forces than a nonreefed parachute for equivalent deployment velocities. Therefore, the reefed parachute can be deployed safely at a higher velocity. From a system point of view, parachute reefing can minimize distance traveled by permitting maximum allowable deceleration forces to be applied to the escape system early in the ejection sequence and by distributing the parachute induced loads over a relatively large portion of the total parachute operating time. A reefed parachute has been successfully integrated into the ACES II ejection seat system and, when combined with mortar-type deployment, has provided superior system performance in terms of distance traveled and consistency of operation, with g-levels well within accepted limits. (Author)

**A74-23556** The decline in USAF ejection survival rates. R. H. Shannon (USAF, Directorate of Aerospace Safety, Norton AFB, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 137, 139-141.

During the period Jan. 1, 1969-Dec. 31, 1972, the USAF has experienced a significant decline in ejection/extraction survival rates. This period produced the lowest ejection survival rate for a single calendar year in the history of USAF ejection experience, and on two occasions the survival rate was less than 80 per cent. This paper presents an analysis of the mechanisms of ejection/extraction injuries and deaths to determine the reason(s) for the declining survival rates. Areas of study include causative agents of fatal and major injuries, relative to conditions at time of ejection, i.e., aircraft altitude, attitude, indicated airspeed and descent rate, and type escape system. The influence of training or the lack thereof on the decision-making process is also addressed. (Author)

**A74-23557** T-38/F-5 improved escape system development and qualification testing. R. M. Gibb and M. M. Orozco (Northrop Corp., Aircraft Div., Los Angeles, Calif.). In: Survival and Flight Equipment Association, Annual Symposium, 11th, Phoenix, Ariz., October 7-11, 1973, Proceedings. Canoga Park, Calif., Survival and Flight Equipment Association, 1974, p. 142-145.

The T-38 aircraft ejection seat developed by Northrop in 1958-60 has remained basically unchanged from 1960 to the present

time. This paper is a summary of the development and qualification testing by Northrop of an improved system for use on the T-38/F-5A/B aircraft. The tests were recently concluded at Holloman AFB in August 1973. The report was presented at the Eleventh Annual SAFE Symposium in the form of a slide/film narrative.

(Author)

**A74-23572** # A two-component statistical model for processing data from a rarefied-gas experiment (Dvukhkomponentnaia statisticheskoi obrabotki eksperimental'nykh dannykh). E. V. Alekseeva and R. N. Miroshin. *Aerodinamika Razrezhen-nykh Gazov*, no. 6, 1973, p. 5-8. In Russian.

**A74-23573** # Construction of a displacement body in a rarefied gas on the basis of a statistical processing of experimental data (Postroenie tela vytesneniia v razrezhennom gaze na osnove statisticheskoi obrabotki eksperimental'nykh dannykh). N. V. Vasil'eva. *Aerodinamika Razrezhennykh Gazov*, no. 6, 1973, p. 10-12. In Russian.

**A74-23595** Piloting techniques and flying qualities of the next generation of aircraft. J.-C. L. Wanner (Direction Techniques des Constructions Aéronautiques, Paris, France). (*Association Française des Ingénieurs et Techniciens de l'Aéronautique et de l'Espace and Royal Aeronautical Society, Journée Louis Blériot, 24th, London, England, Apr. 22, 1971.*) *Aeronautical Journal*, vol. 77, Dec. 1973, p. 593-605. Translation.

Investigations have shown the necessity of reducing crew workloads in order to improve flight safety of military and civil aircraft. The study led to a definition of the various components of a modern cockpit: a head up display featuring the velocity vector, potential climb angle, horizon, and synthetic runway; a head down display giving the necessary data concerning the flight phases when airborne (climb, cruise, descent, and approach); and a ministick and autopilot to handle the aircraft, with a gust alleviation device to improve passenger and crew comfort. F.R.L.

**A74-23596** A status summary of the MRCA project. G. Madelung (Panavia Aircraft GmbH, Munich, West Germany). *Aeronautical Journal*, vol. 77, Dec. 1973, p. 606-611.

The air intakes of the multirole combat aircraft (MRCA) are forward of the wing, and their duct is remarkably straight, minimizing boundary layer effects and distortion. Two interfaces are of particular basic interest: the compatibility of the air intake with the engine, and the afterbody-nozzle shaping together with the thrust reverser. The after fuselage-nozzle combination was analyzed and tested in the wind tunnel to arrive at a proper design tradeoff between base drag, thrust, and weight. The early prototype aircraft will concentrate on handling, propulsion, structural loads, performance, and general subsystems. The later prototypes will do avionics system and external stores work. F.R.L.

**A74-23598** An application of some aspects of optimal control. J. W. Hardy (British Aircraft Corp., Ltd., Stevenage, Herts., England). *Aeronautical Journal*, vol. 77, Dec. 1973, p. 625-633. 9 refs. Research sponsored by the British Aircraft Corp. and Ministry of Defence (Procurement Executive).

Two of the major areas which have been explored have been the optimal design of systems, according to a quadratic performance criterion, and nonlinear programming techniques. It is shown how it is possible to apply the techniques of optimal control to a practical problem, i.e., the design of a missile autopilot. A basic description of the autopilot and the problem facing its designer are given. The problem is posed again in a form convenient for the application of state space techniques. A systematic procedure for the optimization of the autopilot is described, using these techniques in conjunction with a nonlinear programming technique. F.R.L.

**A74-23599 \*** Technology for low noise aircraft - The NASA Quiet Engines. C. C. Ciepluch (NASA, Lewis Research Center, Quiet Engine Project Office, Cleveland, Ohio). *Noise Control Engineering*, vol. 1, Autumn 1973, p. 68-73.

Review of the major goals, procedures, and results of the Quiet Engine Program that was initiated four years ago and is now nearing completion. This program has developed and demonstrated, in full-scale, experimental engine tests, technology advances which, if applied to the design of future aircraft, will help produce equipment with noise levels considerably lower than the older narrow-body aircraft and significantly lower than the new wide-body aircraft flying at present. However, the application of this noise reduction technology will result in increases in aircraft operating costs. Future aircraft noise reduction research should, therefore, consider improvements in the economics associated with noise reduction technology.

M.V.E.

**A74-23693 #** The atmosphere and flight vehicle motion control (Atmosfera i upravlenie dvizheniem letatel'nykh apparatov). E. P. Shkol'nyi and L. A. Maiboroda. Leningrad, Gidrometeoizdat, 1973. 308 p. 120 refs. In Russian.

An analysis is made of the probability characteristics of the physical parameters of the atmosphere in the lowest 100-km layer on the basis of a statistical treatment of rocket sounding data. The special features of the distribution of the air temperature, pressure, and density in the dense layers of the atmosphere are discussed, as well as the structure of the wind field in the troposphere, stratosphere, and mesosphere. A study is made of the vertical statistical structure of the physical parameters of the air in the dense layers of the atmosphere. A number of statistical models are described which are capable of representing the air temperature and density fields and the wind velocity components. A series of statistical methods of studying the motion of flight vehicles in the dense layers of the atmosphere is proposed. The effect of atmospheric perturbations on the motion of flight vehicles in the dense layers of the atmosphere is investigated. Methods of numerical optimization of flight vehicle motion control algorithms are considered, as well as the problem of statistical prediction of the motion of flight vehicles in the dense layers of the atmosphere.

A.B.K.

**A74-23698 #** The use of computer technology in civil aviation (Primenenie vychislitel'noi tekhniki v grazhdanskoi aviatsii). V. V. Musatov. Moscow, Izdatel'stvo Transport, 1973. 320 p. 25 refs. In Russian.

A study is made of the problems connected with the use of computer technology and automatic control systems for the automation of civil aircraft ground operations. Among the topics discussed are elements of analog computers, including elements simulating mathematical operations, functional converters, and operational amplifiers; and elements of electronic digital computers, including arithmetic and memory devices, and the principles of design of digital computers. The use of computer technology is discussed, including the principles of modeling algebraic and differential equations, methods of preparing problems for solution on analog and digital computers, methods of introducing and removing data from digital computers, and methods of converting forms of information. Finally, the use of digital computers for automating civil aircraft control processes is considered.

A.B.K.

**A74-23718** A compact derotator design. D. S. L. Durie (Bell Aerospace Co., Buffalo, N.Y.). *Optical Engineering*, vol. 13, Jan.-Feb. 1974, p. 19-22. Army-supported research.

Description of the optical and mechanical design of a derotator unit using a delta prism. Comparisons with other derotation prisms demonstrate the space and weight savings the delta prism makes possible. Curves showing the dependence of input field of view and apex angle on refractive index are presented.

M.V.E.

**A74-23784** International Telemetry Conference, Washington, D.C., October 9-11, 1973, Proceedings. Conference sponsored by the International Foundation for Telemetry. Pittsburgh, Instrument Society of America (ITC Proceedings, Volume 9), 1973. 540 p. \$25.

Advanced telemetry systems and techniques are described in a series of papers giving detailed information on design considerations and performance characteristics of transmitters, receivers, recorders, reproducers, and processing systems. Some of the systems and equipment described include discrete address beacon systems, Omega position location equipment, multistate analog and digital integrated circuits, electro-optic systems, and optical links. Some experiments, techniques, and applications considered include the influence of carrier frequency on SNR for FM systems, crossplay compatibility of wide-band recorders/reproducers, high speed airborne data acquisition, interferometer signal demodulation, determination of optimal accumulation time in particle flux registration, multiple-phase digital signals, satellite relay techniques, majority-logic decodable codes, radio frequency interference measurements, telemetry of fetal cardiac activity, and telemetry standards.

P.T.H.

**A74-23785** A discrete address beacon system. D. R. Israel (FAA, Office of Systems Engineering Management, Washington, D.C.). In: International Telemetry Conference, Washington, D.C., October 9-11, 1973, Proceedings. Pittsburgh, Instrument Society of America, 1973, p. T-11.

The two most basic requirements for air traffic control are surveillance and communications. The surveillance system in use today is the Air Traffic Control Radar Beacon System. It is based on World War II technology and is experiencing severe difficulties as the number of aircraft carrying transponders increases. This paper outlines the present FAA program to develop a new surveillance system which will eliminate the problems, will be compatible with the existing system, and will also provide a digital data-link for collision avoidance and air traffic control purposes.

(Author)

**A74-23786** A synchronized Discrete Address Beacon System. N. A. Blake (FAA, Office of Systems Engineering Management, Washington, D.C.). In: International Telemetry Conference, Washington, D.C., October 9-11, 1973, Proceedings. Pittsburgh, Instrument Society of America, 1973, p. T-17.

The Federal Aviation Administration is developing a Discrete Address Beacon System as a new air traffic control surveillance system. It will solve most of the problems of the present beacon system and will also provide an integral digital data-link for ground to air messages. This paper describes a particular implementation of the DABS concept which also provides air-to-air collision avoidance service and navigation service.

(Author)

**A74-23787 \*** The advanced OPLE for search and rescue. J. C. Morakis (NASA, Goddard Space Flight Center, Greenbelt, Md.) and W. Rupp (U.S. Naval Air Test Center, Patuxent River, Md.). In: International Telemetry Conference, Washington, D.C., October 9-11, 1973, Proceedings. Pittsburgh, Instrument Society of America, 1973, p. 19-28.

Recent technological advances have made it possible to develop an advanced OMEGA position location experiment for a global search and rescue application. This application generated some new problem areas such as the OMEGA lane ambiguity, random access, location accuracy, real time processing, and size and weight of the Search and Rescue Communication (SARCOM). This experiment will demonstrate the feasibility of instantaneous alarm and position location by using a relatively inexpensive, battery operated, three-pound package. This package can transmit the alarm and position through a synchronous satellite to a search and rescue station in less than three minutes.

(Author)

- A74-23788 \*** Vanguard/PLACE experiment system design and test plan. R. E. Taylor (NASA, Goddard Space Flight Center, Greenbelt, Md.). In: International Telemetering Conference, Washington, D.C., October 9-11, 1973, Proceedings. Pittsburgh, Instrument Society of America, 1973, p. 29-48, 21 refs.

A system design and test plan are described for operational evaluation of the NASA-Goddard position location and aircraft communications equipment (PLACE), at C-band (4/6 GHz), using NASA's ship, the USNS Vanguard, and the ATS-3 and ATS-5 synchronous satellites. The sea test phase, extending from Mar. 29, 1973 to Apr. 15, 1973 has been successfully completed; the principal objectives of the experiment were achieved. Typical PLACE-computed, position-location data are shown for the Vanguard. Position location and voice-quality measurements were excellent; ship position was determined within 2 n mi; high-quality, 2-way voice transmissions resulted as determined from audience participation, intelligibility and articulation-index analysis. A C-band/L-band satellite trilateration experiment is discussed. (Author)

- A74-23830** Universal air-ground data link system. T. Williamson (FAA, Washington, D.C.). In: International Telemetering Conference, Washington, D.C., October 9-11, 1973, Proceedings. Pittsburgh, Instrument Society of America, 1973, p. 508-512.

With the implementation of a nationwide Air Traffic Control (ATC) automation system nearly completed the Department of Transportation/Federal Aviation Administration is devoting considerable attention to the integration of a data link capability into the system. A description is given of the universal data link system, and details of the system's characteristics are presented. A possible configuration of the data link system with the ATC automation system is also presented. (Author)

- A74-23837 #** The development and prospects of helicopters. R. G. Austin (Westland Helicopters, Ltd., Yeovil, Somerset, England). *Aircraft Engineering*, vol. 46, Feb. 1974, p. 4-10.

Productivity tends to be a good indication of the market value of helicopters. Apart from its contribution to productivity, a further attribute gained by efficient increase in speed is an improvement in the ability to maintain schedules and retain range capability in the face of headwinds. The trend of the cruising speeds of helicopters over the past 20 years has approximately doubled. In the not too distant future, without any particularly sophisticated engineering, it should be possible to produce medium to large helicopters capable of cruising efficiently at 200 kt plus. The use of wings, in addition to offering an improved aerodynamic efficiency, in off-loading the rotor will also help to keep the rotor fluctuating loads to acceptable levels. Attention is given to scheduled maintenance and overhaul, unscheduled maintenance, rotor hubs, control systems, and gearboxes. F.R.L.

- A74-23838 #** Lockheed S-3A Viking - Structure with carrier suitability characteristics. *Aircraft Engineering*, vol. 46, Feb. 1974, p. 12-15.

The airframe of the Lockheed S-3A Viking antisubmarine aircraft consists of the wing, horizontal and vertical tails, all control surfaces, alighting gear, nacelle assemblies including the pylon upon which each is mounted, and stores pylons. The arresting gear consists of a titanium A-frame drag link attached to the fuselage so that it pivots vertically, a titanium hook shank attached at the apex of the A-frame so that it pivots laterally, and a hook point made of A-286 steel coated with Colmonoy No. 6 attached at the aft (lower) end of the shank. Systems, the windshield, observer windows and canopy, and electronic equipment are described. F.R.L.

- A74-23839 #** Lockheed S-3A Viking - With low fuel consumption over a wide power range the TF34-GE2 has high thrust to weight. *Aircraft Engineering*, vol. 46, Feb. 1974, p. 18-21.

- A74-23840 #** Lockheed S-3A Viking - Fuel system excludes management and control manipulation. *Aircraft Engineering*, vol. 46, Feb. 1974, p. 24-26.

The fuel system of the Lockheed S-3A Viking is a simple state of the art system which is designed to minimize system maintenance and provide a very high probability of mission success. It requires no fuel management or manipulation of system controls during a normal mission. It is designed to use MIL-J-5624G grades JP-4 and JP-5 turbine fuel. Systems described are engine feed, wing tank transfer, auxiliary tank transfer, refuelling and defuelling, jettison, vent, and quantity gauging. Controls and indicators are discussed. F.R.L.

- A74-23841 #** Lockheed S-3A Viking - The advanced stabilized ejection seat has three sub-systems. *Aircraft Engineering*, vol. 46, Feb. 1974, p. 27.

The ESCAPAC IE-1 advanced stabilized ejection seat system was developed for successful recovery of 4 crewmen at speeds of 0 to 450 kt. Three new subsystems are featured in this new ESCAPAC version: a STAPAC gyro controlled vernier rocket pitch stabilization subsystem, a rocket type man/seat separation system, and a yaw thruster/aero vane subsystem to provide lateral divergence of trajectories for the 4-place application. The system features a highly reliable automatic escape sequence that is activated by either of two controls which initiate the firing system. A manual backup also is provided to allow over-the-side bailout, as well as emergency ground egress from the cockpit. F.R.L.

- A74-23877** The Aeritalia-Lockheed agreement - The package also includes the Lancer (L'accordo Aeritalia-Lockheed - Nel pacchetto c'è pure il Lancer). I. Coggi. *Aviazione di Linea, Difesa, e Spazio*, vol. 12, Feb. 1974, p. 58-60. In Italian.

Consideration of the implications of an agreement concluded recently concerning collaboration between Italian and U.S. firms with regard to marketing of the G-222 military transport and the F-104 supersonic fighter (the Starfighter) and production of a successor to this fighter called the Lancer. Certain discrepancies between the Italian and U.S. communiqués issued following the agreement are noted, giving rise to the conclusion that production of the Lancer is contingent on successful marketing of the G-222 and the F-104. A detailed description is given of the characteristics of the Lancer, showing how it maintains many of the characteristics of the F-104, while achieving improved maneuverability and eliminating the pitchup phenomenon typical of the Starfighter. A.B.K.

- A74-23878** Obsolescence of commercial aircraft - When, where, how (L'obsolescenza degli aerei di linea - Quando, dove, come). A. M. Bolognesi. *Aviazione di Linea, Difesa, e Spazio*, vol. 12, Feb. 1974, p. 64-66. In Italian.

Consideration of the factors giving rise to obsolescence of commercial aircraft which are still capable of productive service. A distinction is made between the length of service of an aircraft with its first buyer and its complete life span, thus bringing out the point that obsolescence does not necessarily mean a total waste of the aircraft. The factors characterizing the phenomenon of obsolescence are examined, from the entry into service of the first jet aircraft to the later orientation toward faster, longer-range aircraft to the current orientation toward increased comfort and silence. The development of a second-hand market particularly in Africa, where air transport is the only rational means of modern transport, is discussed. A.B.K.

- A74-23962** Recent developments and utilization criteria of titanium alloys in the aircraft industry (Développements récents et critères d'emploi des alliages de titane pour l'industrie aéronautique). R. Molinier, L. Séraphin, R. Tricot, and R. Castro (Ugine Aciers, Ugine, Savoie, France). *Revue de Métallurgie*, vol. 71, Jan. 1974, p. 1-17, 40 refs. In French.

Recently accomplished titanium technology advances conducive to expanding application opportunities and improved titanium-alloy performance in aircraft engines and airframes are examined in light

of the basic criteria governing the utilization of titanium in these two important application areas. Prospects of further progress are reviewed, along with future titanium-alloy utilization trends. M.V.E.

**A74-23963** Heat-resistant titanium alloys - Introduction of the UT651A alloy (Les alliages de titane résistant à chaud Présentation de l'alliage UT651A). L. Séraphin, R. Tricot, and R. Castro (Ugine Aciers, Ugine, Savoie, France). *Revue de Métallurgie*, vol. 71, Jan. 1974, p. 19-36. 35 refs. In French. Research supported by the Services Techniques de l'Aéronautique.

Following a review of the general metallurgical characteristics specific of heat-resistant titanium alloys, and a discussion of some of the essential requirements for their utilization in aircraft jet engines, the thermomechanical properties of a new alloy, derived from the older TA6 ZrD alloy, are presented and compared. The superior hardenability of the new alloy is shown to suggest its use in compressor disks. M.V.E.

**A74-23967** Utilization of titanium and its alloys in the manufacture of helicopters and airplane frames (Utilisation du titane et de ses alliages dans la fabrication des hélicoptères et des cellules d'avions). A. Bourgeois and G. Sertour (Société Nationale Industrielle Aérospatiale, Suresne, Hauts-de-Seine, France). *Revue de Métallurgie*, vol. 71, Jan. 1974, p. 87-98. In French.

**A74-24017** # Use of methods based on compound control theory in landing-phase control of an aircraft (Ispol'zovanie metodov teorii kombinirovannogo upravleniia pri upravlenii samoletom na etape posadki). A. F. Taratin (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR). *Metody Issledovaniia i Optimizatsiia Slozhnykh Sistem Upravleniia*, no. 1, 1973, p. 49-55. In Russian.

Analysis of the possibility of using shared-control concepts to improve the landing-phase control accuracy of an aircraft having an onboard digital computer that performs control functions. The control-input transfer function is determined, and transient processes are calculated for a specific numerical example used to demonstrate improvements in accuracy. T.M.

**A74-24022** # Response speed of a correlator in an extremal system for aircraft wheel braking (Bystrodeistvie korreliatora ekstremal'noi sistemy tormozheniia kolek samoleta). V. A. Rodkevich and V. A. Tarasov (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR). *Metody Issledovaniia i Optimizatsiia Slozhnykh Sistem Upravleniia*, no. 1, 1973, p. 76-82. In Russian.

The extremal wheel-braking system examined contains a correlating device whose inputs consist of centered random components of the wheel angular velocity and of the wheel friction moment upon contact with the runway. The output signal corresponds to a derivative of the coefficient of wheel friction on the runway with respect to the wheel angular velocity. The response time of the system is examined, and it is shown that the time required for gathering sufficient information about the location of the wheel operating point on the extremal curve does not exceed 0.7 sec at a threshold SNR equal to unity. T.M.

**A74-24024** # A simulator of wind gust disturbances (Imitator vetrovykh vozmushchaiushchikh vozdustvii). S. Ia. Avramenko, B. N. Stel'makh, and V. V. Skorokhod (Leningradskii Institut Aviatsionnogo Priborostroeniia; Leningradskii Elektrotekhnicheskii Institut Sviazi, Leningrad, USSR). *Metody Issledovaniia i Optimizatsiia Slozhnykh Sistem Upravleniia*, no. 1, 1973, p. 88-94. 7 refs. In Russian.

Low-level atmospheric turbulence is analyzed as a real source of disturbances acting on an automatic landing system for aircraft, and a wind-gust simulator is described for use as an artificial source of disturbances in analog computer studies of automatic landing systems. The simulator employs binary noise with a Poisson distribution of level-transition times as the primary disturbance

source. Examples illustrate design computation of shaping filters in the simulator. T.M.

**A74-24027** # A device for measuring the power of an aircraft wheel brake (Izmeritel' moshchnosti tormoza aviakolesa). M. G. Perov (Leningradskii Institut Aviatsionnogo Priborostroeniia, Leningrad, USSR). *Metody Issledovaniia i Optimizatsiia Slozhnykh Sistem Upravleniia*, no. 1, 1973, p. 108-113. In Russian.

Description of a so-called multiplier device for measuring the power of an aircraft wheel friction brake. The proposed device is based on the multiplication of the variable friction force (or friction moment) by the slip rate of the disks of the friction couple with the aid of an asynchronous motor. The device described is fairly accurate (a 3.2% error) and is simple to construct. A.B.K.

**A74-24052** Air-traffic-control simulator for the training of ATC personnel (Ein ATC-Simulator zur Ausbildung von Flugsicherungspersonal). W. Schmidt. *Wissenschaftliche Berichte AEG-Telefunken*, vol. 46, no. 3-4, 1973, p. 85-92. In German.

Description of the design, operation, and performance potential of an ATC-simulation system that simulates both aircraft motions and radar indications. A digital computer controls the system, whose primary purpose is the training of air traffic controllers. The flexibility of the system makes it possible to simulate the participation of 'approaching-aircraft pilots' and to test the merits of new ATC techniques. M.V.E.

**A74-24058** # Note on the aerodynamic theory of oscillating T-tails. H. T. Ichikawa and K. Isogai (National Aerospace Laboratory, Tokyo, Japan). (*Japan Society for Aeronautical and Space Sciences, Annual Meeting, 3rd, Tokyo, Japan, Apr. 6, 1972*) *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 16, no. 34, 1973, p. 209-224.

A theory of laterally oscillating T-tails is presented by extending the theory given in part one. By the use of the method of matched asymptotic expansions, the boundary-value problem is divided into four problems: the symmetrical and antisymmetrical first-order problems, and the symmetrical and antisymmetrical second-order problems. Boundary conditions (normal wash equations), integral equations in terms of vortices, and equations of pressure difference for each problem are derived and discussed. It is made clear that the existing theories for oscillating T-tails correspond to the antisymmetrical first-order problem and that the antisymmetrical second-order problem must be solved in order to predict the dihedral effect of the stabilizer due to angle of attack. (Author)

**A74-24061** # A method of obtaining transonic shock-free flow around lifting aerofoils. S. Takanashi (National Aerospace Laboratory, Tokyo, Japan). *Japan Society for Aeronautical and Space Sciences, Transactions*, vol. 16, no. 34, 1973, p. 246-263. 19 refs.

Exact solutions for shock-free transonic flows around lifting aerofoils are sought by means of the hodograph method. The procedure of constructing compressible flows from known incompressible flows is, in its principle, similar to that of Nieuwland. In the present theory, however, the original incompressible flow solution is divided into two parts in the hodograph plane; one is the complex velocity potential of the flow around a circular cylinder with circulation and the other is a specific auxiliary function which is regular at the point corresponding to infinity in the physical plane. The split of the solution simplifies the computation remarkably. (Author)

**A74-24132** Boeing freeze's AMST prototype design. R. G. O'Lone. *Aviation Week and Space Technology*, vol. 100, Mar. 18, 1974, p. 38, 39, 41.

The final configuration of the Boeing YC-14 design, intended for entry in USAF's advanced medium STOL transport (AMST) prototype competition, is discussed. It is believed to represent a blend of advanced technology and economy, well suited to meet



USAF's requirements and to provide a solid basis for a commercial derivative. The major changes (none of them dramatic) from the original proposal of November, 1972 are examined. V.P.

**A74-24225** Properties of high-strength aluminum P/M products. J. P. Lyle, Jr. and W. S. Cebulak (Alcoa Technical Center, Alcoa Center, Pa.). *Metals Engineering Quarterly*, vol. 14, Feb. 1974, p. 52-63. 5 refs. Research supported by the Aluminum Company of America and U.S. Army.

Better combinations of strength, resistance to stress-corrosion cracking, and resistance to exfoliation corrosion can be obtained in forgings and extrusions made from pre-alloyed atomized powder than in corresponding products made from ingot. High-cycle smooth-specimen fatigue resistance was superior and notch fatigue resistance was equal to that of 7075-T6 conventionally fabricated from ingot. Good transverse toughness has resulted from process improvements. Internal quality meeting SNT Class A Airframe Ultrasonic Test Standards can be obtained consistently. (Author)

**A74-24297** # Study of the speed of fatigue crack propagation in the case of light alloys and titanium alloys (Etude de la vitesse de propagation des fissures de fatigue dans le cas des alliages légers et des alliages de titane). G. Sertour and G. Hilaire (Société Nationale Industrielle Aérospatiale, Suresnes, Hauts-de-Seine, France). In: *Fatigue: Relations between metallurgical and mechanical aspects*; Conference on Metallurgy, 15th, Saclay, Essonne, France, June 21, 22, 1972, Proceedings. Gif-sur-Yvette, Essonne, France, Institut National des Sciences et Techniques Nucléaires, 1973, p. 337-354. In French.

**A74-24312** # Pégase project - Advantages of a lens-shaped hull (Projet Pégase - Intérêt d'une forme de carène lenticulaire). P. Balaskovic (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (Association d'Etude et de Recherche sur les Aéronefs Allégés, Colloque, Paris, France, Nov. 12-14, 1973.) ONERA, TP no. 1310, 1973. 11 p. In French.

Description of a telecommunications project involving the launching of a number of platforms in the form of dynamically anchored stationary stratospheric dirigibles. The originality of this project lies not only in the altitude at which these platforms will function (20,000 m) but also in the lens shape planned for the hulls of the dirigibles. To compare the performances of a hull of this shape with that of a hull of classical streamlined shape, a study is made of a parabolic-profile lens with a relative thickness of 0.25 and a streamlined body defined by an ellipsoid of revolution with a relative thickness of 0.15 corresponding to a large classical dirigible. The results of a feasibility study leading to the definition of an initial model are presented, as well as the results of a study of a simplified mathematical model which makes it possible to evaluate the effect of various physical and structural parameters on the total mass of the dirigible. A.B.K.

**A74-24314** # Some aerodynamic problems raised by the airship (Quelques problèmes aérodynamiques posés par le ballon dirigeable). L. Cabot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (Association d'Etude et de Recherche sur les Aéronefs Allégés, Colloque, Paris, France, Nov. 12-14, 1973.) ONERA, TP no. 1312, 1973. 16 p. In French.

After recalling the aerodynamic peculiarities of the free and the tethered balloon, the paper gives a survey of the airship aerodynamic characteristics, as recorded on old machines (especially the Akron), in wind tunnel and in flight. The unstable nature of the airframes is emphasized, as well as the associated piloting problems. (Author)

**A74-24315** # Advanced composite materials - Solution to problems of structure weight reduction (Les matériaux composites - Solution à l'allègement des structures). J.-P. Favre

(ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (Association d'Etude et de Recherche sur les Aéronefs Allégés, Colloque, Paris, France, Nov. 12-14, 1973.) ONERA, TP no. 1313, 1973. 15 p. 11 refs. In French.

The weight-related specific strength properties of advanced composite materials are reviewed and compared with those of steel, aluminum, and titanium alloys for use in aircraft structures. It is shown that the selection and use of composite materials poses many problems such as adequate matching of reinforcing fibers and service stresses, in terms of load carrying capacities and load magnitudes as well as in fiber orientation and stress direction, proper joining of composite and metal structures, etc. Upon the judicious solution of such problems does the ultimate cost efficiency of composite material structures depend. M.V.E.

**A74-24324** # Semi-Markovian models in problems of designing flight-vehicle control systems (Polu-Markovskie modeli v zadachakh proektirovaniia sistem upravleniia letatel'nyimi apparatami). I. N. Kovalenko, G. K. Moskatov, and E. Iu. Barzilovich. Moscow, Izdatel'stvo Mashinostroenie, 1973. 175 p. 71 refs. In Russian.

A mathematical approach to the solution of problems associated with designing and servicing flight-vehicle control systems is outlined. It is based on the theory of semi-Markov random processes and on the theory of queueing problems. Markov processes with a finite or denumerable set of states, and imbedded Markov chains are examined. An elementary theory of optimum cut-off of a random sequence is proposed and is used as a basis for developing optimal control methods. The analytical results are applied to the solution of problems encountered in designing and servicing flight vehicle control systems. Methods of calculating the reliability of adaptive autopilots are demonstrated by examples. V.P.

**A74-24325** # Automatic flight control systems and their analytic design (Sistemy avtomaticheskogo upravleniia poletom i ikh analiticheskoe konstruirovaniie). A. A. Krasovskii. Moscow, Izdatel'stvo Nauka, 1973. 560 p. 191 refs. In Russian.

A systematic account is given of the purpose, design, and operation of a number of typical aircraft and helicopter control systems. A number of mathematical models of an aircraft as a control plant are considered, including simple models of longitudinal and lateral motions and a more complex model of spatial motion with allowance for aeroelasticity of the aircraft structure. A study is made of manual control systems or aircraft stability and controllability systems, including dampers, stability control devices, and transmission ratio controllers. Other topics discussed are autopilots and angular stabilization systems, semiautomatic and automatic systems for landing approach and aircraft navigation in the region of an airport, landing control systems, systems for guiding aircraft to air and ground targets, helicopter control systems, and spacecraft control systems. A.B.K.

**A74-24375** \* The acoustic far-field of rigid bodies in arbitrary motion. F. Farassat (Cornell University, Ithaca, N.Y.; NASA, Langley Research Center, Hampton, Va.). *Journal of Sound and Vibration*, vol. 32, Feb. 8, 1974, p. 387-405. 13 refs.

The far-field sound produced by a rigid body in arbitrary motion, with shock discontinuities close to the body, is studied. The analysis is based on the work of Ffowcs Williams and Hawkins (1969). An expression for the far-field sound pressure is obtained in the form of surface and line integrals carried out over a contracting sphere and its intersection with the body and shock surfaces. It is also found that in addition to the quadrupole distribution, the discontinuities in Lighthill stress at the shock, the fluid stresses at the body surface, and the curvatures (principal and mean) of the body and shock surfaces contribute to the sound field. Two examples are worked out. (Author)

**A74-24378** # Unsteady aerodynamic characteristics of cascades of arbitrary profiles vibrating in the potential flow of an

incompressible fluid (Nestatsionarnye aerodinamicheskie kharakteristiki reshetok proizvol'nykh profilei, vibriruiushchikh v potentsial'nom potoke neszimaemoi zhidkosti). V. P. Riabchenko. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1974, p. 15-20. 7 refs. In Russian.

**A74-24393 #** Shock wave shape associated with a nonsymmetric hypersonic flow around a circular cone (O forme udarnoi volny pri nesimmetrichnom giperzvukovom obtekanii krugovogo konusa). N. V. Zolotova. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1974, p. 170-172. 5 refs. In Russian.

**A74-24396 #** Some results of an optical study of supersonic spatial flows (Nekotorye rezul'taty opticheskogo issledovaniia sverkhzvukovykh prostranstvennykh techenii). V. N. Alekseev and A. L. Gonor. *Akademiia Nauk SSSR, Izvestiia, Mekhanika Zhidkosti i Gaza*, Jan.-Feb. 1974, p. 179-185. 14 refs. In Russian.

Description of a shadow imaging technique which uses standard equipment for spatial flow visualization with a boundary-to-boundary crossflow illumination which cannot be achieved by other methods when the flow is about a body of complex configuration. A specific feature of this technique is the positioning of a point light source at the apical point of the body to obtain an illuminated flow segment well accessible to cross observations. The theory and implementation of this technique are discussed. The technique is applied to a flow about a delta wing or a straight dihedral wing, and to the interior of V-shaped wings. V.Z.

**A74-24423** Influence of heat on crack propagation and residual strength and its relation to the supersonic aircraft fatigue problem. R. D. J. Maxwell, W. T. Kirkby, and J. R. Heath-Smith (Royal Aircraft Establishment, Structures Dept., Farnborough, Hants., England). *ASTM, ASME, and IME, International Conference on Creep and Fatigue in Elevated Temperature Applications, Sheffield, England, Apr. 1-5, 1974, Paper*, 9 p. 19 refs.

**A74-24473** Lifting surface problems analysis. K. Washizu (Tokyo, University, Tokyo, Japan) and M. Ikegawa (Hitachi Co., Ltd., Tokyo, Japan). In: *Theory and practice in finite element structural analysis; Proceedings of the Seminar*, Tokyo, Japan, November 5-10, 1973. Tokyo, University of Tokyo Press; Portland, Ore., International Scholarly Book Services, Inc., 1973, p. 573-582. 14 refs.

The finite-element technique is applied to obtain numerical solutions of integral equations. Two steady aerodynamic problems in the lifting surface theory are taken as examples. It is shown that the accuracy of numerical results obtained by the finite-element technique is encouraging. Although the examples treated are limited, extensions of the present method to other integral equations are straightforward. (Author)

**A74-24668** F-15 test progress. 1 - F-15 offers superior maneuverability. C. Martin. *Aviation Week and Space Technology*, vol. 100, Mar. 25, 1974, p. 40, 41, 43.

Test progress data indicate that the McDonnell Douglas F-15 is easier to operate and is considerably more agile in air combat than other supersonic fighters in the USAF inventory. The new fighter means a return to the doctrine that emphasizes close-in aerial combat with short-range weapons, a result of lessons received over North Vietnam. Details are given on systems, flight performance, and maneuverability of the fighter. V.Z.

**A74-24671 #** Aircraft noise and sound suppression (Fluglärm und Schalldämpfung). F. Dubs. *Aero-Revue*, Mar. 1974, p. 146-148. In German.

The various factors involved in curbing the noise of propeller-driven aircraft are reviewed, along with a recently designed sound absorbing system. The human auditory spectrum, the decibel and phon noise scales, and human perception of noise intensity are discussed, and noise sources in propeller aircraft as well as Swiss legal provisions in effect on permissible aircraft noise levels are outlined. A novel and effective sound attenuation system is then described that uses the conjugated aerodynamic effects of an injector and resonator in a manner involving no reduction either in engine power output, or in flight safety or engine life. M.V.E.

**A74-24697** Astafan - A new concept from Turbomeca. N. Williams. *Shell Aviation News*, no. 421, 1974, p. 22-27.

Stemming from the basic design concept of the Turbomeca Astazou, the Astafan is a constant speed ducted fan engine. It is a marriage between the low bypass engine and the turboprop. In effect, the propeller was removed from an Astazou and a high bypass fan was fitted. The Astafan 111 has a bypass ratio of 8:1. The constant engine speed goes a long way toward preventing surge and flame extinction, and the airflow behind the fan is assisted by a double set of stator blades before reaching the main gas generator intake. Specific fuel consumption is only 0.365 lb/lb/hr, and takeoff thrust is 1740 lb, which with water injection increases to 1870 lb. The Astafan can make use of its reverse capability as an airbrake. Handling characteristics and procedures are discussed in detail. F.R.L.

**A74-24840 \*** Case studies in Aircraft Parameter Identification. R. K. Mehra (Harvard University, Cambridge, Mass.) and J. S. Tyler (Systems Control, Inc., Palo Alto, Calif.). In: *Identification and system parameter estimation; Proceedings of the Third Symposium, Delft, Netherlands, June 12-15, 1973, Part 1*. Amsterdam, North-Holland Publishing Co., 1973, p. 117-144. 38 refs. Contracts-No. NAS1-10700; No. N00014-67-A-0298-0006.

Three case studies in Aircraft Parameter Identification using simulated data for X-22-VTOL aircraft and flight test data for HL-10 and M2/F3 lifting bodies. After a brief discussion of the previous techniques and their limitations, a technique based on the Maximum Likelihood criterion is described. The problems of identifiability and uniqueness in determining the Stability and Control derivatives from flight test data are discussed and several methods for alleviating these problems are presented. The flight test data is analyzed in several different ways for obtaining physically meaningful estimates for the aircraft parameters. (Author)

**A74-24842** On some problems related to the identification of aircraft parameters. V. Klein and D. A. Williams (Cranfield Institute of Technology, Cranfield, Beds., England). In: *Identification and system parameter estimation; Proceedings of the Third Symposium, Delft, Netherlands, June 12-15, 1973, Part 1*. Amsterdam, North-Holland Publishing Co., 1973, p. 435-444. 6 refs.

The methods of identification used in the evaluation of aircraft parameters are the equation error method and the output error method. The second method involves the weighted least squares estimation, maximum likelihood estimation and Bayesian estimation procedures. Both methods are covered by one computing programme. The accuracy and sensitivity of various solutions and the effect of certain model errors are discussed and covered by examples. (Author)

**A74-24843** Estimation of aircraft parameters in nonlinear aerodynamic models. W. R. Wells (Cincinnati, University, Cincinnati, Ohio). In: *Identification and system parameter estimation; Proceedings of the Third Symposium, Delft, Netherlands, June 12-15, 1973, Part 1*. Amsterdam, North-Holland Publishing Co., 1973, p. 445-448. 12 refs.

An algorithm for the extraction of stability and control derivatives from noisy high angle-of-attack flight data is presented. The results are applicable to the six-degree-of-freedom rigid body aircraft motion in the absence of turbulence (no process noise). The algorithm is based on the maximum likelihood method applied to a nonlinear aerodynamic model. (Author)

**A74-24856 Aircraft performance measurements in non-steady flights.** J. A. Mulder (Delft, Technische Hogeschool, Delft, Netherlands). In: Identification and system parameter estimation; Proceedings of the Third Symposium, Delft, Netherlands, June 12-15, 1973, Part 2. Amsterdam, North-Holland Publishing Co., 1973, p. 1131-1145. 13 refs.

This paper discusses some aspects of the determination of aircraft performance from measurements in nonsteady flight conditions. It is shown that additional variables must be measured compared to the conventional technique of measuring performance during steady flight. The gain is a remarkable reduction in required flight test time. Performance has been derived by means of maximum likelihood estimation. The Cramer-Rao lower bound theorem has been applied to calculate the maximally achievable accuracies of performance derived from nonsteady flight data. (Author)

**A74-24868 \* # Experimental and theoretical investigation of HT-S/PMR-PI composites for application to advanced aircraft engines.** M. P. Hanson and C. C. Chamis (NASA, Lewis Research Center, Cleveland, Ohio). In: The wide world of reinforced plastics; Proceedings of the Twenty-ninth Annual Conference, Washington, D.C., February 5-8, 1974. New York, Society of the Plastics Industry, Inc., 1974, p. 16-C.1 to 16-C.10.

A combined experimental and theoretical investigation was performed in order to: (1) demonstrate that high quality angleplied laminates can be made from HT-S/PMR-PI (PMR in situ polymerization of monomeric reactants), (2) characterize the PMR-PI material and to determine the HT-S unidirectional composite properties required for composite micro and macromechanics and laminate analyses, (3) select HT-S/PMR laminate configurations to meet the general design requirements for high-tip-speed compressor blades. The results of the investigation showed that: HT-S/PMR laminate configurations can be fabricated which satisfy the high-tip-speed compressor blade design requirements when operating within the temperature capability of the polyimide matrix. (Author)

**A74-24892 Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1972 (Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrbuch 1972).** Edited by H. Blenk and W. Schulz. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1973. 507 p. In German. Members, \$15.45; nonmembers, \$20.85.

Advances in the kinetics of multibody systems are discussed together with problems concerning the flying qualities of future transport aircraft, the understanding and prediction of turbulent flow, the development of spacecraft propulsion systems in West Germany, and contributions to the mechanics of fluids and gases in weak-gravity fields. Other subjects explored include problems of supersonic and hypersonic combustion, the catalytic induction of hydrogen combustion in hypersonic ram jets, the calculation of recirculation flows in the case of VTOL propulsion systems, and problems of the aerodynamic heating of reentry bodies.

G.R.

**A74-24894 Problems concerning the flying qualities of future transport aircraft (Flugeigenschaftsprobleme zukünftiger Transportflugzeugentwicklungen).** X. Hafer (Darmstadt, Technische Hochschule, Darmstadt, West Germany). In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1972.

Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1973, p. 27-50. 25 refs. In German.

One of the approaches which can be employed for overcoming the problems posed by the steadily increasing air traffic is the use of large aircraft. The effect of an enlargement of aircraft size on the flying qualities is investigated, giving particular attention to the flight characteristics of the aircraft during the landing approach. Problems concerning the flying qualities in connection with the longitudinal and the lateral motion are examined. Problems connected with a decrease in the landing speed are also explored, taking into account changes in the lift parameters, velocity-dependent rocking vibrations at low flying speeds, and the effect of aerodynamic coupling in the case of stationary side slipping. G.R.

**A74-24895 Technical aspects of the VFW 614 (Technische Aspekte der VFW 614).** W. Seibold (Vereinigte Flugtechnische Werke-Fokker GmbH, Bremen, West Germany). (Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972.) In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1972. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1973, p. 121-145. In German.

The VFW 614 is a short-range airliner which is to replace the aircraft types presently used for short air routes. The aircraft needs only short takeoff runs. This factor will make it possible for the VFW 614 to use also the airports of smaller cities. The aircraft has a cruising speed of 735 km/h and can carry from 40 to 44 passengers. Details of aircraft design are discussed together with questions of aircraft control, propulsion system design, and information regarding the noise produced by the engine. G.R.

**A74-24896 Air traffic confronted with dangers inherent in the trends of evolution. (Luftverkehr im Gefahrenfeld der Entwicklungstendenzen).** W. Güldimann (Eidgenössisches Luftamt, Berne, Switzerland). (Deutsche Gesellschaft für Luft- und Raumfahrt, Jahrestagung, 5th, Berlin, West Germany, Oct. 4-6, 1972.) In: Deutsche Gesellschaft für Luft- und Raumfahrt, Yearbook 1972. Cologne, Deutsche Gesellschaft für Luft- und Raumfahrt, 1973, p. 158-172. 23 refs. In German.

Problems of air-traffic developments are connected with hijacking incidents in which a comparatively large number of airliners were involved. The general political background responsible for the hijackings is examined together with approaches for reducing as far as possible the number of such incidents. Other problems are related to aspects of a certain disintegration of the international air traffic community with regard to the legal regulations of air traffic operations. The environmental effects of air traffic are also considered, giving attention to aircraft noise and air pollution. The rapidly increasing volume of air traffic is responsible for a number of other problems which have to be solved. G.R.

**A74-24958 \* # Vortex-induced heating to cone flaps at Mach 6.** J. N. Hefner and A. H. Whitehead, Jr. (NASA, Langley Research Center, Hampton, Va.). *Journal of Spacecraft and Rockets*, vol. 11, Mar. 1974, p. 200. 201. 5 refs.

Discussion of the local heating effect on the lee-side control flaps of supersonic configurations due to the interaction between vortices and leeward control surfaces at an angle of attack. Considerations are given for an appropriate positioning of control flaps to alleviate such interactions and the resulting thermal effect. Tests are carried out on a sharp right circular cone with two types of flap configurations in a study of oil flow patterns about the cone at selected angles of attack. Splitting of flaps and moving them to positions away from the symmetry plane did reduce the heating but also reduced the average flap pressure and increased flow complexity. V.Z.

**A74-24995 # Automatic control systems for flight-vehicle engines (Sistemy avtomaticheskogo upravleniya dvigateliami letatel'nykh apparatov).** V. A. Bodner, Iu. A. Riazanov, and F. A.

Shaimardanov. Moscow, Izdatel'stvo Mashinostroenie, 1973. 248 p. 12 refs. In Russian.

Synthesis methods and the principal of designing multivariable control systems for turboprop, turbojet, ducted-fan, and gas turbine jet engines are discussed, and the mathematical models of these engines are presented. Particular attention is given to a matrix synthesis method based on the theory of approximation of functions. Computer algorithms and tables which can be used for determining the optimal control-system parameters are given. Some aspects of signal conversion and signal processing in digital control systems are examined, together with methods of analyzing transient processes during takeoff at large deviations of the control parameters. The effectiveness of using a time-energy-reliability criterion in the synthesis of optimal control systems is demonstrated. V.P.

**A74-24998 # Aircraft acoustics (Aviatsionnaya akustika).** Edited by A. G. Munina and V. E. Kvitki. Moscow, Izdatel'stvo Mashinostroenie, 1973. 448 p. 255 refs. In Russian.

Theoretical and experimental studies of aerodynamic noise are described, and noise abatement methods are examined. The principal sources of aircraft noise, such as gas jets, compressors, turbulent boundary layers, propellers, and sonic bangs are studied. Data are presented which can be used to determine the near and far-field acoustic characteristics of aerodynamic sources, as a basis for calculations of aircraft noise, cockpit noise, and the acoustic endurance of aircraft structures. V.P.

**A74-25024 Diffusion welding of structural components for aeronautics and astronautics (Zum Diffusionsschweißen von Bauteilen für die Luft- und Raumfahrt).** K. Gerber (Dornier-System GmbH, Friedrichshafen, West Germany). *Raumfahrtforschung*, vol. 18, Jan.-Feb. 1974, p. 38-41. In German. Research supported by the Bundesministerium der Verteidigung.

Diffusion welding as a modern technique for the fabrication of sandwich structures and integral plates with high thermal and mechanical loads is especially well suited for the requirements of special aerospace products. The report presents the results of tests with diffusion-welded probes made from aluminum, titanium and steel alloys. Finally the fabrication of some structure elements is described. (Author)

**A74-25027 # Interconnections in grounding and shielding devices for electronic equipment (Perekhodnye kontakty v ustroystvakh zazemleniya i ekranirovaniya radioelektronnoi apparatury).** N. M. Kondrashkin. Moscow, Izdatel'stvo Sovetskoe Radio, 1973. 136 p. 17 refs. In Russian.

The requirement for use of lightweight magnesium and aluminum alloys and the adverse environmental factors intrinsic to aircraft operations pose special problems in ensuring good electrical contacts when grounding on-board electrical equipment and when interconnecting structural elements to prevent static charges. The present work examines mechanisms responsible for degradation of such electrical contacts and provides design data for bolts, screws, terminals, grounding lugs, bus bars, flexible leads and similar hardware used to ground electronic equipment, aircraft fixed and movable structural sections, fuel tanks, and various avionics elements. Metallization and coating requirements are described in detail. T.M.

**A74-25038 Technical optimization (Technisches Optimieren).** F. Zach (Wien, Technische Hochschule, Vienna, Austria). Vienna, Springer-Verlag, 1974. 291 p. 176 refs. \$37.80. In German.

Basic definitions related to optimization concepts are considered together with the fundamental mathematical tools of optimization. Optimization criteria are discussed along with the maximum principle, practical optimization methods, numerical optimization methods, aspects of dynamic programming, the optimum estimation

of system variables, adaptive systems, multivariable systems and hierarchic control, and learning systems for the optimization of control systems. Questions concerning an optimization with the aid of variational calculus are also explored, giving attention to an example involving an optimum maneuver for landings on the planet Mars. G.R.

**A74-25061 # The CCV concept and specifications (Concept CCV et specifications).** J.-C. Wanner (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (NATO, AGARD, Symposium on Aircraft Design Integration and Optimization, Florence, Italy, Oct. 1-5, 1973.) ONERA, TP no. 1282, 1973. 7 p. In French.

The controlled configuration vehicle (CCV) concept involves design-phase evaluation of possibilities offered by systems providing static stability compensation, maneuver load control, antiturbulence measures, and active flutter control. The advent of new electronic systems and control actuators may relax, traditionally employed aircraft natural stability requirements, and the present work evaluates the need for new specifications applied to aircraft designed according to the CCV concept. Emphasis is placed on the reliability aspects of avionics systems. While classical flight quality criteria can be applied to aircraft based on CCV design concepts without modification, newer relaxed criteria require improved methods for evaluating failure probabilities of avionics systems. T.M.

**A74-25062 Aerodynamic problems of the short takeoff and landing aircraft (Problèmes aérodynamiques de l'avion à décollage et atterrissage courts).** R. Cérésuela (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). (*L'Aéronautique et l'Astronautique*, no. 41, 1973, p. 43-56.) ONERA, TP no. 1247, 1973. (p. 43-56), 14 p. 18 refs. In French. (Translation).

There are three characteristic aspects in the study of these aircraft. First, using the engine air flow to induce most of the lifting forces generated by the wing confers a new severity to the definition of the behavior in case of engine failure. Second, the important circulation around the wing, and the variations in angle of attack and skidding due to gusts applied at low speeds subject the aircraft lifting surfaces to highly deflected flow configurations, at present very difficult to predict through calculation. Third, a constraint relative to noise, recently made even more severe, is added to other design constraints to complicate the economic optimization of projects by the enforced rejection of solutions that would be aerodynamically attractive but are prohibitively noisy. F.R.L.

**A74-25213 A shock tube study of the formation of carbon particles during the pyrolysis of hydrocarbons.** A. J. Gosling, D. Lampard, and D. E. Fussey (Nottingham University, Nottingham, England). In: Combustion Institute, European Symposium, Sheffield, England, September 16-21, 1973, Proceedings.

London, Academic Press, Inc. (London), Ltd., 1973, p. 388-393. 5 refs. Research supported by the Science Research Council and Nottingham University.

Gaseous fuels in an inert carrier gas were subjected to pyrolysis by a conventional incident shock technique, taking into account a pressure range from 0.02 to 0.04 bar and a temperature range from 1100 to 1400 K. Data were obtained for the time intervals between the shock passage and the first appearance of solid carbon particles. This induction time was related to the gas temperature and density. The investigation discussed forms the preliminary stage of a program which will ultimately investigate the pyrolysis of aircraft fuels at representative combustion chamber pressures. G.R.

**A74-25308 # Effect of transient phenomena on the responses of aircraft to gusts and comparison between calculations and experiments (Influence des phénomènes transitoires sur les réponses des avions aux rafales et confrontations des calculs à l'expérience).** R. Hirsch and H. Lethuy. *Association Aéronautique et*

*Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 37 p. In French.*

Review of the modeling procedure employed in establishing a computer program for calculating the response of an aircraft to a gust, and comparative study of theoretically predicted values and experimental measurements made on free-flight models passing through a gust. In the modeling procedure employed the aircraft is assumed to consist of a wing which is capable of flexural deformation in a fundamental mode, a fuselage equally liable to flexural deformation under the same conditions, and a horizontal tail unit. An effort is made to take into account a pure delay corresponding to the time lag existing between the moment when the gust reaches the tail unit and the moment when it touches the wing. The comparison of theoretical and experimental values is performed for two aircraft models of the same weight and wingspan, but differing in that one has a high-wing profile, while the other has a low-wing profile.

A.B.K.

**A74-25310 # Buffeting tests with a swept wing in the transonic range** (Essais de buffeting d'une aile en flèche en transsonique). B. Monnerie and F. Charpin (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 30 p. In French.*

A model of the transport-aircraft M6 wing was used to study the characteristics of three-dimensional subsonic and transonic flows in general and the phenomenon of buffeting in particular. In spite of their preliminary tentative nature, the data obtained indicate that the motion of the model has little effect on the aerodynamics and that if this finding is confirmed by future tests with various geometries, it should be possible to study buffeting quantitatively from the nonstationary pressures measured on the wing.

V.P.

**A74-25311 # Progress in the techniques of free flight studies of catapulted models - Application to aircraft response to vertical gusts** (Progrès dans les techniques d'études sur maquettes catapultées en vol libre - Application à la réponse des avions aux rafales verticales). R. Verbrugge (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 59 p. In French.*

**A74-25316 # Wind-tunnel investigations aimed at devising tests of aircraft spin** (Etudes en souffleries relatives à l'installation d'essais en vol de vrilles sur avions). J. Gobeltz and M. Vanmansart (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 42 p. In French.*

The nature and characteristics of and the conditions leading to aircraft spin are studied in a conventional and in a spin wind tunnel, using an anemometer technique adapted for this purpose. The results obtained provide better insight into the spin phenomenon, and form a basis for developing means of recovering from spin. The use of a parachute and of auxiliary jets as a means of mastering aircraft spin is studied.

V.P.

**A74-25317 # Review of developments in test techniques using free-floating models** (Aperçu des développements dans les techniques d'essais sur maquettes libres). J. Gobeltz (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 45 p. In French.*

A test facility and test conditions permitting the use of free-floating aircraft models are described. The advances made in the

preparation of test models and measurement and processing techniques are reviewed, and experience obtained in spin tests, tests of landing on water, of aircraft response to vertical gusts, and crash tests is examined. The direct application of model-test data to the actual aircraft on the basis of the Froude similarity is evaluated. Conditions are examined under which the tests can be extended to include the ground effect, the landing of STOL and VTOL aircraft, landing in cross-wind, and the influence of lateral gusts.

V.P.

**A74-25319 # Example of aerodynamic instability under supercritical conditions about profiles** (Exemple d'instabilité aérodynamique en régime supercritique autour de profils). A. Dymont and P. Gryson (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 26 p. 7 refs. In French.*

An instability phenomenon observed at peak supercritical velocities about wing profiles is studied. It is caused by the viscosity of the fluid, and involves shock-induced turbulent boundary layer separation alternating with reattachment at the leading edge. Wind-tunnel investigations of the phenomenon are described, and an explanation for it is proposed.

V.P.

**A74-25320 # Measurements of gusts on Concorde** (Mesures de rafales sur Concorde). R. Dieudonné (Société Nationale Industrielle Aérospatiale, Paris, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 30 p. In French.*

The response of the Concorde to wind gusts generated in a wind tunnel and to gusts encountered under flight conditions is studied. The open-throat wind-tunnel experiments were performed with models of the wing alone, the wing plus fuselage, and the complete aircraft, including engines. The experimental response curves are correlated with a Runge-Kutta solution of the equations of motion.

V.P.

**A74-25321 # Experimental and theoretical study of the transonic flow past a half-wing** (Etude expérimentale et théorique de l'écoulement transsonique autour d'un demi-profil). J. Delery, P. Laval, and J. J. Châtot (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 34 p. 25 refs. In French.*

A technique for studying the behavior of boundary layers on transonic wings from interferograms of the flow is described. It is shown how interferograms obtained with a Mach-Zehnder interferometer can be used to study the flow pattern about the wing and the structure of the dissipative layers. Diagrams showing the pressure measured from the interferograms, and the Mach numbers deduced from the pressures are presented and discussed. Comparative calculations are carried out by two methods: a technique for solving the nonstationary Euler equations, and a technique based on the equation of small transonic perturbations.

V.P.

**A74-25322 # Noise silencers at military test stands** (Les silencieux de bancs d'essais militaires). D. Dechy (Etablissements André Boet, Villeneuve-d'Ascq, Nord, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 26 p. In French.*

The acoustic and aerodynamic characteristics of devices used to suppress the noise of jet engines whose performance parameters are checked on military transportable test stands are discussed. Analysis of various noise-silencer designs shows that the air-cooled version offers numerous advantages, including a substantial reduction in internal corrosion.

V.P.

**A74-25326 # Calculation, design, and testing of a model of transonic flutter** (Calculs, réalisation et essais d'une maquette de flottement transsonique). J. Brisebarre; J. P. Brevan (Avions Marcel Dassault, Paris, France), and F. Dupriez (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 53 p. 9 refs. In French.*

A detailed study is made of the possibility of simulating transonic flutter in small wind tunnels, including methods of carrying out static and dynamic tests of flutter on beams and the results of actual tests carried out in wind tunnels. A theoretical study is made of the laws of modal similarity and of the similarity of flutter in compressible flow, the determination of base ratios is discussed, and methods of providing the data necessary for modeling a structure are discussed, as well as the planform calculations required for the realization of a model. A description is given of static tests of beam deformation and the displacement of points on the surface of a structure, and of dynamic tests on structural elements and on complete models. Finally, the results of wind-tunnel tests with sting mountings on steel cables are cited. A.B.K.

**A74-25327 # Experimental study of the aerodynamic noise of airfoils** (Etude expérimentale du bruit aérodynamique des profils). J. P. Bridelance and R. Ouziaux (Ecole Nationale Supérieure d'Arts et Métiers, Châlons-sur-Marne, Marne, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 19 p. In French. Research supported by the Etablissements NEU.*

Analysis of the noise intensity level generated by a flow with a low background noise past an airfoil or a blade cascade. A particular effort is made in this study to separate the respective influences of pure sounds and turbulence noise and to indicate possible applications of the findings obtained to the design of low-noise turbofans. It is confirmed that the Strouhal number is the fundamental parameter in the cases studied. It is shown that the characteristic length which must be chosen for calculating the Strouhal number is the chord in the case of turbulence noise and the airfoil thickness in the case of pure sounds. A.B.K.

**A74-25328 # Experience gained from a comparison of spins on wind-tunnel models and on aircraft** (Enseignements tirés de la comparaison de vrilles sur maquettes en soufflerie et sur avions). L. Beaurain (Lille I, Université, Lille, France). *Association Aéronautique et Astronautique de France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 36 p. In French.*

Results of wind-tunnel and full-scale tests of the effects of spin on three types of non-French aircraft. A detailed analysis is made of the character of stabilized spin, the special features of flat and rapid spin, and appropriate maneuvers for getting out of spin in the case of the Swiss P3 light trainer aircraft, the character of stabilized spin and maneuvers for getting out of spin in the case of the BAC Lightning fighter aircraft, and the spin characteristics and maneuvers for getting out of spin in the case of the Hawker-Siddeley Harrier VTOL aircraft. It is shown how the testing techniques and the interpretation of wind-tunnel phenomena have been developed as a function of certain conclusions drawn from a comparison of model and full-scale results. Certain experience that can be gained from a series of spin tests on an aircraft, particularly with regard to spins occurring subsequent to the tests, is indicated. Finally, information is given concerning the type of geometrical modification that must be made in an aircraft which has a critical spin. A.B.K.

**A74-25329 # Modeling dynamic stall on an oscillating airfoil** (Modélisation du décrochage dynamique d'un profil oscillant). N. Baudu, M. Sagner, and J. Souquet (Société Bertin et Cie., Plaisir, Yvelines, France). *Association Aéronautique et Astronautique de*

*France, Colloque d'Aérodynamique Appliquée, 10th, Université de Lille I, Lille, France, Nov. 7-9, 1973, Paper. 19 p. 11 refs. In French.*

Description of the main features of a method of determining the pressure distributions on an oscillating airfoil in the presence of separated sheets. In the proposed method the separated sheets formed at the leading edge of the airfoil during dynamic stall are represented by vortex sheets in a flow which is otherwise irrotational. On the one hand, the configuration of the vortex locus is very similar to that of the vortex sheet obtained by visualization, while, on the other hand, the pressures on the airfoil, as well as the polar curves, are similar to the experimental values. A.B.K.

**A74-25351 # The use of chromium anodic protection /the BF 4 process/ for the detection of metallurgical anomalies in light alloys** (Utilisation de la protection anodique chromique /procédé BF 4/ pour la révélation des anomalies métallurgiques dans les alliages légers). J. Faesch (SGL, Suresnes, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 11 p. In French.*

**A74-25352 # New frontiers of civil aeronautics** (Les nouvelles frontières de l'aéronautique civile). C. Abraham (Transports Aériens Réunis, Aéroport de Nice, Nice, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 15 p. In French.*

The future development of civil aviation is discussed from the viewpoint of new constraints dictated by considerations of the quality of life and the economic environment. Factors considered include reduction of noise levels, sonic boom hazards, engine exhaust and toxic emission regulations, the availability of aircraft fuels, transport time intervals, availability of airspace, and airport capacity and access problems. The nature of problems posed by each of these factors is discussed along with promising solutions. T.M.

**A74-25353 # Measurements of runway adherence and problems of braking in the regulation of landing distances** (Les essais de mesure d'adhérence des pistes et les problèmes de freinage dans la réglementation sur les distances d'atterrissage). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 16 p. In French.*

**A74-25355 # Requirements and trends in collision avoidance** (Nécessités et tendances en matière d'anticollision). J. Taillat (ONERA, Châtillon-sous-Bagneux, Hauts-de-Seine, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 32 p. 20 refs. In French.*

The aims of collision avoidance systems are reviewed, and various imperative conditions are given which will have to be met before systems now under development can pass into the operational stage. Principal criteria considered are reliability, precision, cost, and compatibility with ground-control systems. The systems proposed by the principal manufacturers are described, and their operational principles are analyzed. The systems are classified according to the previously discussed criteria, although it was not deemed possible to formulate any value judgments that could lead to the choice of the best system. P.T.H.

**A74-25356 # Some air traffic control problems and trends in their resolution**. R. M. Soward (EUROCONTROL, Brussels,

Belgium). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 39 p. 14 refs.*

**A74-25357 #** The new constraints on military aircraft (Les nouvelles contraintes de l'aéronautique militaire). J. Soissons. *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 12 p. In French.*

A clause that appears regularly at the end of military aircraft specifications, requiring the new weapon system to be 'robust, low-cost, and easy to maintain' is studied in the light of the constraints imposed on the design, development, and manufacture of new generation military aircraft by current economic trends, fiscal policy, and rapidly increasing cost of advanced materials and technological sophistication. Some aspects of possible tradeoffs between costs and sophistication are examined. V.P.

**A74-25358 #** Considerations regarding the regulation of aircraft noise (Reflexions sur la réglementation du bruit des avions). M. Pianko (Direction Technique des Constructions Aéronautiques, Services Technique Aéronautique, Paris, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 39 p. In French.*

According to existing regulations, noise is a factor that affects the design of an aircraft similarly to flight performance requirements and service specifications. The present work provides a critical evaluation of the objectives and methods of noise regulation as currently practiced. The interests and viewpoints of various concerned parties (communities in the vicinity of airports, aircraft manufacturers, airlines, and airport management) are examined, and attention is given to means of rationalizing the concepts and principles of acoustic certification. T.M.

**A74-25359 #** Structural research with the aim of adapting the design to the materials (La recherche structurale en vue d'adapter l'architecture aux matériaux). R. Mordellet (Société Nationale Industrielle Aérospatiale, Paris, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 19 p. In French.*

The new materials, in particular composites, used in aircraft construction can only be effectively utilized by modification of design. The aim would be to take the best advantage of certain of their special properties, such as anisotropy and durability. Simplification of design will have to be implemented in order to alleviate the effects of their higher cost. P.T.H.

**A74-25360 #** Problems associated with the implementation of an air-ground data link (Problèmes liés à la mise en oeuvre d'un système data-link air-sol). A. Michel (Secrétariat Général à l'Aviation Civile, Service Technique de la Navigation Aérienne, Paris, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 26 p. In French.*

Factors affecting the design and application of digital data links between aircraft and ground control centers are examined. The organization of a data link system is discussed from the viewpoints of

communications requirements, frequency bands employed, modes of operation, equipment on board the aircraft, and the ground environment. Attention is given to system scale requirements as dictated by ATC functions, aeronautical data transmissions, airline communications, and other applications. Current research on modulation techniques and transmission modes is reviewed. T.M.

**A74-25361 #** Systems integration - Avionics of tomorrow (L'intégration des systèmes - Avionique de demain). J. Monfort (Délégation Ministérielle pour l'Armement, Paris, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 14 p. In French.*

Discussion of engineering aspects and systems architecture considerations involved in the task of integrating novel avionics equipment and subsystems into the overall aircraft design concept. Advantages offered by digital techniques are discussed in areas of measurement, data processing, information display, enhanced compatibility of different equipment, and communications. Systems planning tasks considered involve interfacing of on-board avionics elements, computational and management functions, and interfacing with the external environment. Problems of transition from present avionics systems to advanced future techniques are also examined. T.M.

**A74-25362 #** Automatic approach of helicopters and STOL aircraft (L'approche automatique des hélicoptères et des avions ADAC). J.-C. Grisard (Société de Fabrication d'Instruments de Mesure, Massy, Essonne, France). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 18 p. In French.*

An automatic piloting system is described giving helicopters a satisfactory approach capability under zero visibility conditions. The system consists essentially of coupling with a MWLS beam. The particular advantages of helicopters (small landing area, steep approach) can be maintained. The results of numerous tests with an Alouette III and an SA 330 are summarized. P.T.H.

**A74-25363 #** The application of electron beam welding for major titanium structures. M. G. Drönsch (Messerschmitt-Bölkow-Blohm GmbH, Munich, West Germany). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 37 p.*

Electron beam (EB) welding is considered an essential process in the economical application of titanium if full advantage is to be taken of the metal's characteristics. EB welding and conventional fusion welding are compared in graphs and diagrams. An EB welding machine used for the joining of wing pivot bearings is described. Problems of cost reduction in series production and requirements of quality assurance are discussed. P.T.H.

**A74-25364 #** Aerodynamic/structural interactions in the design of the Concorde nacelle. T. W. Coombe, H. A. Goldsmith, and D. F. Morris (British Aircraft Corp., Ltd., London, England). *Association Aéronautique et Astronautique de France and Union Syndicale des Industries Aéronautiques et Spatiales, Congrès International Aéronautique, 11th, Ecole Nationale Supérieure de Techniques Avancées, Paris, France, May 21-23, 1973, Paper. 36 p.*

This paper examines the overall design of the Concorde nacelle from the point of view of the interaction of aerodynamic and structural requirements. It is shown that in general the influence of aerodynamics has been dominant, with the structure having to conform to the aerodynamic requirements as efficiently as possible.



However, in some areas structural and weight considerations have played a major part. (Author)

**A74-25399** Maximum space utilization of a C47 aircraft for remote sensing. R. D. Worsfold (Canada Centre for Remote Sensing, Ottawa, Canada). In: Remote Sensing of Earth Resources; Proceedings of the Second Conference on Earth Resources Observation and Information Analysis System, Tullahoma, Tenn., March 26-28, 1973. Volume 2. Tullahoma, Tenn., F. Shahrokhi, University of Tennessee, 1973, p. 249-267. 6 refs.

Two derivatives of the 'Personal Plane Modification' carried out on C47 aircraft are discussed. A Dakota 12931 was modified to have four identical sensor bays which could accommodate almost any type of remote sensing equipment. Aft of the four bays a fifth special purpose bay was constructed. The installation of electrical controls on aircraft is discussed together with the design of instrumentation racks, a closed circuit television system, operational tests, and questions of evaluation. It is pointed out that any agency wanting to modify an aircraft for remote sensing purposes must plan their requirements for three to five years in advance. G.R.

## STAR ENTRIES

**N74-17699\*** National Aeronautics and Space Administration. Lewis Research Center, Cleveland, Ohio.

**COLD-AIR STUDY OF THE EFFECT ON TURBINE STATOR BLADE AERODYNAMIC PERFORMANCE OF COOLANT EJECTION FROM VARIOUS TRAILING-EDGE SLOT GEOMETRIES. 1: EXPERIMENTAL RESULTS**

Herman, W. Prust, Jr. and Wayne M. Bartlett. Washington Mar. 1974 29 p refs  
(NASA-TM-X-3000; E-7743) Avail: NTIS HC \$3.25 CSCL 01A

Trailing-edge slot configurations were investigated in a two-dimensional cascade of turbine stator blades. The trailing-edge slots were incorporated into blades with round trailing edges. The five blade configurations investigated included blades with two different trailing-edge thicknesses and four different slot widths. The results of the investigation showed that there was, in general, a significant increase in primary-air efficiency due to the coolant flow, the increase varying with slot configuration. For the five configurations tested, the average percent change in primary-air efficiency per percent coolant flow varied almost linearly from zero to about 1.4 percent over a range of coolant-to primary-air exit-velocity ratios between 0 and 1.2. However, for different configurations there was considerable deviation from the average values in the lower range of exit velocity ratios.

Author

**N74-17700#** Nagoya Univ. (Japan).

**THE MINIMUM INDUCED DRAG OF THE HEMI-ELLIPTIC GROUND EFFECT WING**

Hiroshi Manada and Shigenori Ando. 6 Aug. 1973 49 p  
Presented at Meeting of Japan Soc. for Aeron. and Space Sci., Nagoya, 20 Nov. 1972. Backup document for AIAA Synoptic, "Minimum Induced Drag of Hemi-elliptic Ground Effect Wing" scheduled for publication in Journal of Aircraft in May 1974  
Avail: NTIS HC \$5.50 CSCL 01A

A numerical analysis of the minimum induced drag of hemi-elliptic wings in ground effect is presented. The numerical process consisted of series expansion. Numerical results were obtained for two limiting cases. The numerical analysis is based on the assumption that the wing is expressed as the curved lifting line in the plane normal to the free stream.

Author

**N74-17702\*** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**NORMAL LOADS PROGRAM FOR AERODYNAMIC LIFTING SURFACE THEORY**

Richard T. Medan and K. Susan Ray, (Computer Sci. Corp., Mt. View, Calif.) Feb. 1974 94 p refs  
(NASA-TM-X-62326) Avail: NTIS HC \$7.75 CSCL 01A

A description of and users manual are presented for a U.S.A. FORTRAN 4 computer program which evaluates spanwise and chordwise loading distributions, lift coefficient, pitching moment coefficient, and other stability derivatives for thin wings in linearized, steady, subsonic flow. The program is based on a kernel function method lifting surface theory and is applicable to a large class of planforms including asymmetrical ones and ones with mixed straight and curved edges.

Author

**N74-17704#** Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

**SUPERSONIC AND TRANSONIC WIND TUNNEL TESTS ON**

**A SLENDER OGIVE-CYLINDER BODY SINGLE AND IN COMBINATION WITH CRUCIFORM WINGS AND TAILS OF DIFFERENT SIZES. Final Report**

S. E. Gudmundson and L. Torngren. Apr. 1972 115 p refs  
(Contracts INK-11-12-93490; INK-11-12-02871)  
(FFA-AU-772) Avail: NTIS HC \$8.75

Wind tunnel tests were performed at different Mach numbers on a long cylindrical body with long ogive nose. Symmetrical forces were measured for the body alone and for different combinations of body and cruciform wings of two different sizes and cruciform tails of three different sizes. For one wing and tail size two different positions of the wing were tested. Normal force and pitching moment were also measured for the two wings alone. For two model configurations some investigations were made at two Mach numbers of the effect of different boundary layer transition trips. The results were compared with results from other wind tunnels. The agreement between the results is reasonably good.

Author (ESRO)

**N74-17705#** Aeronautical Research Inst. of Sweden, Stockholm. Aerodynamics Dept.

**SUPERSONIC AND TRANSONIC WIND TUNNEL TESTS ON SLENDER OGIVE-CYLINDER BODY SINGLE AND IN COMBINATION WITH CRUCIFORM WINGS AND TAILS OF DIFFERENT SIZES**

S. E. Gudmundson and L. Torngren. Apr. 1972 108 p  
(Contracts INK-11-12-93490; INK-11-12-02871)  
(FFA-AU-772-Suppl) Avail: NTIS HC \$8.50

For abstract see, N74-17704.

**N74-17707#** Messerschmitt-Boelkow-Blohm G.m.b.H., Otto-brunn (West Germany).

**RECIPROCAL INFLUENCE OF A BODY OF FINITE LENGTH AND A WING AT MID-WING POSITION AT SUBSONIC SPEED [ZUR GEGENSEITIGEN BEEINFLUSSUNG EINES ENDLICH LANGEN RUMPFES UND EINES FLUEGELS IN MITTELDECKERANORDNUNG BEI UNTERSCHALL-STROEMUNG]**

G. Gregoriou. Bonn Bundeswehramt 1973 41 p refs. In GERMAN; ENGLISH summary. Sponsored by Bundesmin. der Verteidigung  
(BMVg-FBWT-73-33) Avail: NTIS HC \$5.25; Bundeswehramt, Bonn 30 DM

Based on potential theory an iterative singularity-method was developed which yields the pressure distribution of symmetric wing-body configurations at angle of attack at subsonic speed. The body is axisymmetric and of finite length. The wing is infinitely thin and located at mid-wing position. The results obtained were compared to both the results of other theories and the results of several wind tunnel tests.

Author (ESRO)

**N74-17709#** National Physical Lab., Teddington (England). Aerodynamics Div.

**LOW-SPEED AERODYNAMIC CHARACTERISTICS OF NACA 0012 AEROFOIL SECTION. INCLUDING THE EFFECTS OF UPPER-SURFACE ROUGHNESS SIMULATING HOAR FROST**

N. Gregory and C. L. O'Reilly. Aeron. Res. Council 1973 35 p refs. Supersedes ARC-31719; N71-11016  
(ARC-R/M-3726; ARC-31719) Avail: NTIS HC \$4.75; HMSO £1.35; PHI \$5.30

Aerodynamic characteristics of NACA 0012 airfoil section at Reynolds numbers of 2.88 million and 1.44 million with some indications of scale effect at other Reynolds numbers are presented. The measurement of  $C_{sub}$   $L_{max}$  at a Reynolds number of 2.88 million is uncertain. A laminar separation bubble disappears intermittently. The flow broke down into a three-dimensional pattern when an appreciable extent of separation was present. Boundary-layer control by suction in the vicinity of the wing/wall junction is shown to improve the two-dimensionality in the early stages of separation, but does not inhibit the appearance of three-dimensional flow at and beyond the stall. Distributed roughness was progressively applied from the trailing edge forwards over the upper surface of the airfoil. Both sparse and

dense distributions were used and they were intended to simulate the hoar frost deposit remaining after partial cleaning of the forward part of the airfoil. Subject to the above qualifications C sub Lmax, is not greatly reduced until the front edge of the roughness extends forward of 0.1 chord, at which stage also the drag increment due to the roughness rapidly becomes much larger. Author (ESRO)

**N74-17710#** Lockheed-Georgia Co., Marietta. Flight Sciences Div.

**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF VORTEX LIFT CONTROL BY SPANWISE BLOWING. VOLUME 1: EXPERIMENTAL RESEARCH** Final Technical Report, 15 Apr. 1972 - 15 Sep. 1973

C. J. Dixon, J. G. Theisen, and R. M. Scruggs 15 Sep. 1973 123 p refs 2 Vol.

(Contract N00014-72-C-0237; NR Proj. 215-201)

(AD-771290; LG73ER-0169-Vol-1) Avail: NTIS CSCL 01/1

Experimental investigations of spanwise blowing as a means of controlling leading edge vortices and flow separation have been conducted in five phases. Significant results from each phase are reported in this volume. The five (5) phases are: Smoke Tunnel Flow Visualization; Laser Doppler Velocimeter Investigations of the flow field of an under-expanded jet near and parallel to a flat plate; force tests of spanwise blowing over a 45 degree swept horizontal tail configuration; force test with spanwise blowing on an Aspect ratio 4.4, 20 degree swept wing; and pressure tests on the 20 degree wing. (Modified author abstract) GRA

**N74-17711#** Lockheed-Georgia Co., Marietta.

**THEORETICAL AND EXPERIMENTAL INVESTIGATIONS OF VORTEX LIFT CONTROL BY SPANWISE BLOWING. VOLUME 2: THREE-DIMENSIONAL THEORY FOR VORTEX-LIFT AUGMENTATION** Final Technical Report, 15 Apr. 1972 - 15 Sep. 1973

Jerome G. Theisen, Roy M. Scruggs, and Charles J. Dixon 15 Sep. 1973 108 p refs 2 Vol.

(Contract N00014-72-C-0237)

(AD-771304; LG73ER-0169-Vol-2) Avail: NTIS CSCL 01/1

A theoretical description is presented on the experimentally observed phenomenon of wing leading-edge vortex lift control by spanwise mass injection. The vortex and jet initial source/sink strengths and locations are established by a conformal mapping solution, and used as starting conditions for an iterative vortex-lattice simulation. The spanwise jet is shown to augment the stability of a vortex which forms at high angles-of-attack in the leading-edge region where wings of moderate-to-high aspect ratio otherwise exhibit fully turbulent separation. Definitive results are obtained on wing lift and corresponding pressure distributions for comparison with the test data presented in Volume I. (Modified author abstract) GRA

**N74-17715#** Rochester Applied Science Associates, Inc., N.Y. **VORTEX MODIFICATION BY MASS INJECTION AND BY TIP GEOMETRY VARIATION** Final Report

John C. Balcerak and Raymond F. Feller Jun. 1973 97 p refs

(Contract DAAJ02-72-C-0097; DA Proj. 1F1-62204-AA-41)

(AD-771966; RASA-73-01; USAAMRDL-TR-73-45) Avail: NTIS CSCL 01/1

The report describes an experimental research program in which the outer section of a UH-1D helicopter blade was modified to incorporate a system for injecting the trailing tip vortex produced by the blade with a mass of linearly-directed air, and also an Ogee-tip section to study its effect as a passive system on vortex dissipation. The effects of mass injection were investigated at low mass flow rates, at near-sonic injection velocities, and with a two-section nozzle. The results are presented in terms of quantitative measurements of circulation strength as a function of mass flow rate and thrust, and are correlated with the results from previous research done at RASA. Also presented are flow-visualization studies which were conducted using illuminated helium bubbles, smoke, and tuft grids. The results of this

research program present additional confirming evidence that mass injection of the concentrated tip vortex is a practical approach to the elimination of the strong induced effects on a lifting surface of the circulatory flow associated with a concentrated vortex generated at the tip of a helicopter rotor blade.

Author (GRA)

**N74-17718#** Aerospace Research Labs., Wright-Patterson AFB, Ohio.

**WORK UNIT 08 (V/STOL AERODYNAMICS) Final Report, May 1967 - Jun. 1973**

J. S. Petty Nov. 1973 12 p refs

(AF Proj. 7064)

(AD-771811; ARL-73-0164) Avail: NTIS CSCL 01/1

The objective of Work Unit 08(V/STOL Aerodynamics) was the study of the low speed aerodynamics of V/STOL configurations, with particular emphasis on the fan-in-wing. Principal items of research accomplished under WU 08 include studies of airfoils with single and double inlets on their upper surfaces and lift fan inlet interference phenomena. A definitive paper from the German literature on the roll-up of a jet in a cross flow was translated into English. (Modified author abstract)

GRA

**N74-17719#** Naval Postgraduate School, Monterey, Calif. Dept. of Aeronautics.

**AN ALTERNATIVE FORMULATION OF THE LIFTING LINE WING EQUATION AND ITS SOLUTION**

Theodore H. Gawain Dec. 1973 50 p refs

(AD-771981; NPS-57GN73121A) Avail: NTIS CSCL 01/1

In the report, the standard wing equation, as normally derived from lifting line theory, is further refined and a solution procedure more basic than the usual collocation technique is developed. The calculation method adopted avoids the necessity of performing an explicit matrix inversion; all equations can be solved sequentially, one at a time. On the other hand this technique involves the evaluation of numerous integrals over the span. The calculations are cumulative, and can be carried as far as necessary to achieve any required degree of accuracy. The analysis is interesting not only for purposes of practical calculation but also for the light it sheds on the essential mathematical structure of the basic aerodynamic phenomena involved. This same general method of calculation can also be readily adapted to the solution of other common types of engineering problems. Author (GRA)

**N74-17720#** Advisory Group for Aerospace Research and Development, Paris (France).

**FLIGHT IN TURBULENCE**

Nov. 1973 365 p refs Presented at the 42d Meeting of the Flight Mech. Panel of AGARD, Woburn Abbey, England, 14-17 May 1973

(AGARD-CP-140) Avail: NTIS HC \$21.25

The proceedings of a conference on the effects of atmospheric turbulence on aircraft operation are presented. The subjects discussed include the following: (1) characteristics of atmospheric turbulence, (2) aircraft operational problems created by atmospheric turbulence, (3) analysis of wake vortices and wind shear, (4) structural loads and gust criteria, (5) aircraft design for performance under turbulent conditions, and (6) application of energy management concepts to flight path control in turbulence

**N74-17725** Delft Univ. of Technology (Netherlands). Dept. of Aeronautical Engineering.

**PROGRESS IN THE MATHEMATICAL MODELLING OF FLIGHT IN TURBULENCE**

O. H. Gerlach, G. A. J. VandeMoesdijk, and J. C. VanderVaart In AGARD Flight in Turbulence Nov. 1973 38 p refs

Problems of mathematical modelling of aircraft flight in turbulence are discussed. The simulation of flight in the lower atmosphere during the approach and landing portions of the flight are emphasized. The discrepancy between the usual Gaussian representation of atmospheric turbulence and the actual

non-Gaussian atmosphere is analyzed. A parameter is introduced to characterize the actual turbulence sensed by the pilot. A method is presented for finding the range of altitudes at which the most significant disturbances are encountered during the approach.

Author

**N74-17726** British Overseas Airways Corp., London (England). **BOAC EXPERIENCE WITH TURBULENCE**  
Ernest Chambers /in AGARD Flight in Turbulence Nov. 1973 13 p

The effectiveness of airborne radar in giving adequate warning of convective turbulence in clouds is discussed. Some encounters with turbulence in clear air are described and matters relating to the forecasting, reporting, and dissemination of turbulence occurrence are presented. The development of an airborne clear air turbulence detector is recommended and the performance requirements of the detector are developed. Problems with low level wind shear are also examined.

Author

**N74-17727** Deutsche Lufthansa Aktiengesellschaft, Frankfurt am Main (West Germany). Meteorological Dept.  
**AN AIRLINE'S EXPERIENCE ON TURBULENCE**  
Heinz Dreyling /in AGARD Flight in Turbulence Nov. 1973 7 p

A compilation of the replies of airline pilots to a questionnaire on different areas concerned with atmospheric turbulence is presented. An assessment is made on flight times in turbulence, strength and type of turbulence, and the potential effect of turbulence on airline operations. Specific geographical areas as well as airports with specific turbulence encounters are listed, and potential energy sources are mentioned. The turbulence penetration speed is discussed as well as means to avoid turbulent encounters or to alleviate turbulent conditions through air traffic control, meteorological reports, or pilot experience.

Author

**N74-17728** Royal Aircraft Establishment, Farnborough (England).  
**INFLUENCE OF PILOT AND AIRCRAFT CHARACTERISTICS ON STRUCTURAL LOADS IN OPERATIONAL FLIGHT**

J. R. Sturgeon /in AGARD Flight in Turbulence Nov. 1973 24 p refs Presented at the 35th Meeting of the Struct. and Mater. Panel, Toulouse, France, 24-29 Sep. 1972

(AGARD-608)

Some aircraft handling problems met in operational conditions are described and compared with flight test conditions. It is concluded that errors in flight instrumentation and physiological cues have a substantial influence on control capability. A procedure for minimizing structural loads and aerodynamic problems in all flight conditions is proposed. The procedure will restore to the pilot and to the autopilot controlled flying the positive stability in pitch and yaw which is required for aircraft operating in the stick free mode. Proposals are made for improving the requirements of flight instruments to reduce control problems during complex maneuvers and flight in severe wind shear conditions.

Author

**N74-17729** British Aircraft Corp., Warton (England). Military Aircraft Div.  
**AIRCRAFT RESPONSE TO TURBULENCE-CREW COMFORT ASSESSMENTS USING POWER SPECTRAL DENSITY METHODS**  
Brian Young /in AGARD Flight in Turbulence Nov. 1973 9 p refs

The effects of atmospheric turbulence on the efficiency of a flight crew are analyzed. The factors are identified as: (1) atmospheric turbulence levels, (2) the characteristics of the aircraft in responding to turbulence, including the effects of structural modes, and (3) the tolerance of the crew to the level and duration of vibration at the crew station. The use of power spectral density techniques for assessing crew ride comfort is explained. In addition to defining aircraft response in both vertical and lateral turbulence, it is possible to include the effects of structural

modes, assess the effects of autostabilization, and include crew proficiency degradation as a parameter in operational studies.

Author

**N74-17730** Bodenseewerk Geraetetechnik G.m.b.H., Ueberlingen (West Germany).

**THE EFFECT OF GUSTS AND WIND SHEAR FOR AUTOMATIC STOL APPROACH AND LANDING**  
Gunther Schaezner /in AGARD Flight in Turbulence Nov. 1973 17 p refs

The characteristics of a flight control system for short takeoff aircraft are discussed. The system is used during steep and curved approaches. The system was simulated and flight tested during more than 500 automatic STOL approaches and landings. The effects of gusts and wind shear, especially at extremely low indicated airspeeds during approach and flare, with respect to the pilot's workloads, passenger comfort, throttle activity, angle of attack measurement, and precision in approach and landing are analyzed.

Author

**N74-17731** Transportation Systems Center, Cambridge, Mass.  
**THE DETECTION OF AIRCRAFT WAKE VORTICES**  
Ralph D. Kodis /in AGARD Flight in Turbulence Nov. 1973 9 p refs

The hazards created by the trailing vortices deposited in the wakes of heavy jet aircraft are discussed. In the terminal area this hazard leads to longer separation standards and reduced runway capacity. In order to shorten the required separations without compromising safety it is necessary to be able to detect the presence and motion of vortices in regions where they constitute a threat. The sensing techniques that have been developed are reported. The characteristics of acoustic and wind pressure sensors for detecting vortices are described.

Author

**N74-17732** Federal Aviation Administration, Washington, D.C. Office of Systems Engineering Management.  
**WAKE VORTEX AVOIDANCE SYSTEM PROGRAM (WVAS)**  
Lawrence Langweil /in AGARD Flight in Turbulence Nov. 1973 9 p refs

A wake vortex avoidance system (WVAS) program is described. The objective of the program is to design and implement a ground based monitoring and predictive system at airports which will increase runway capacity by eliminating the need for larger separations between aircraft for safety from wake vortices. The program consists of three major tasks: (1) sensor development, (2) vortex behavior characterization and hazard definition, and (3) integration of these tasks into an overall system design. The meteorological factors which affect the performance of the proposed system are analyzed.

Author

**N74-17733\*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**VORTEX WAKE RESEARCH**  
John A. Zalovcjk and R. Earl Dunham, Jr. /in AGARD Flight in Turbulence Nov. 1973 14 p refs

NASA investigations of aircraft trailing vortices are reviewed. Results obtained in flight on vortex characteristics, such as decay of maximum velocity and vortex drift, are presented for distances behind a generating C-5 aircraft from 0.6 to 13.0 nautical miles. The lateral control activity of a CV-990 aircraft probing the vortices generated by the C-5 aircraft is illustrated and the effect of the C-5 aircraft configuration on this activity is indicated. Results are presented from near-field and far-field studies of accelerated vortex dissipation through the use of various devices such as mass ejection, spoilers, vortex generators, and trailing drag devices.

Author

**N74-17734** Aeronautical Research Associates of Princeton, Inc., N.J.

**ON TURBULENCE ENVIRONMENT AND DESIGN CRITERIA**

John C. Houbolt /in AGARD Flight in Turbulence Nov. 1973 15 p refs

Aircraft design criteria based on the effects of atmospheric turbulence are discussed. Emphasis is placed on the power spectral techniques, but equivalences to the discrete-gust procedure are shown. Consideration is given to large design loads, such as limit load and to repeated loads which affect structural fatigue. Mathematical models are provided to illustrate the gust design approaches and the basic spectral procedure. Author

**N74-17735** NATO MRCA Development and Production Management Agency, Munich (West Germany).  
**DESIGN PROBLEMS OF MILITARY AIRCRAFT AS AFFECTED BY TURBULENCE**  
M. Hacklinger /In AGARD Flight in Turbulence Nov. 1973 9 p ref

The influence of atmospheric turbulence on the design of military aircraft is analyzed. The subject is treated in two main categories: (1) turbulence as a sizing factor in itself which determines static and fatigue strength of major parts of low load factor aircraft and (2) turbulence as an important design parameter of high load factor aircraft where stability of the augmented aircraft in manual or automatic terrain following flight, pilot proficiency under vibration, and the attitude accuracy of the aircraft as a weapons platform become important. The problem of designing for proper flight qualities in high speed tactical fighter missions is described with emphasis on analytical prediction of pilot task proficiency under the vibration environment created by airframe and flight control system characteristics. Author

**N74-17736** Messerschmitt-Boelkow G.m.b.H., Ottobrunn (West Germany).  
**INFLUENCE OF TURBULENCE ON HELICOPTER DESIGN AND OPERATION**  
G. Reichert and M. Rade /In AGARD Flight in Turbulence Nov. 1973 16 p refs

The sensitivity of the helicopter to atmospheric turbulence because of the relatively low disc loading is discussed. The influences of other parameters such as rotor stiffness and damping are analyzed. The effects of these influences on different helicopters are compared. The main design problems of meeting operational and certification requirements and methods for improving the performance of helicopters are examined. Author

**N74-17737** De Havilland Aircraft Co., Ltd., Downsview (Ontario).  
**DATA REQUIREMENTS ON TURBULENCE IN THE EARTH'S ATMOSPHERIC SHEAR LAYER FOR STOL DESIGN CRITERIA**  
J. J. Glaser /In AGARD Flight in Turbulence Nov. 1973 8 p refs

The factors which affect the airworthiness of short takeoff aircraft, especially during the landing and takeoff phase of the operation. Atmospheric turbulence is one of the most important factors affecting aircraft behavior at low altitudes, and its description in terms of a realistic model is an essential step in the design, certification, and operation of STOL aircraft. A study to devise a low altitude gust model and to determine the relative importance of the gust model parameters of the responses of typical STOL aircraft was conducted. The significant features of the DHC-3 aircraft which was used in the test are analyzed. Author

**N74-17738** Hawker Siddeley Aviation, Ltd., Hatfield (England).  
**EXPERIENCE WITH A LOW ALTITUDE TURBULENCE MODEL FOR AUTOLAND CERTIFICATION**  
R. M. P. McManus /In AGARD Flight in Turbulence Nov. 1973 8 p ref

The effects of atmospheric turbulence on the autoland system of the Trident aircraft are discussed. The aircraft was instrumented to obtain three axis gust time histories for each landing made. From these time histories a gust model was built up and was used for the initial certification of the automatic landing system. The results obtained with the gust model are compared with the statistical analysis of flight test data to determine the degree of correlation. Author

**N74-17739** British Aircraft Corp., Weybridge (England). Commercial Aircraft Div.  
**STRUCTURAL LOADS AND GUST CRITERIA**  
D. O. N. James /In AGARD Flight in Turbulence Nov. 1973 13 p refs

The effects of atmospheric turbulence on aircraft design criteria are analyzed. The discrete gust methods are compared with the power spectral density methods to determine the degree of application to aircraft gust load problems. The application of continuous turbulence design procedure was investigated. Mission analysis results are shown to be very sensitive to the assumed operating technique. Graphs of specific aircraft design envelope limit loads against the discrete gust load limit are provided. Author

**N74-17740** Royal Netherlands Aircraft Factories Fokker, Amsterdam.  
**RATIONAL CALCULATION OF DESIGN GUST LOADS IN RELATION TO PRESENT AND PROPOSED AIRWORTHINESS REQUIREMENTS**  
J. Yff /In AGARD Flight in Turbulence Nov. 1973 11 p refs

An analysis of accurately calculated gust loads for three short haul aircraft was conducted. The results are applied to the following conditions: (1) comparison of power spectral density and discrete gust methods, (2) comparison of power spectral density mission analysis and design envelope results, (3) comparison of power spectral density results for vertical and lateral gusts, and (4) a study of the specific problems of T-tail configurations. Graphs of load conditions for various aircraft components are provided. Author

**N74-17741** British Aircraft Corp., Warton (England). Military Aircraft Div.  
**C.S.A.S. DESIGN FOR GOOD HANDLING IN TURBULENCE**  
A. G. Barnes /In AGARD Flight in Turbulence Nov. 1973 14 p refs

The design objectives for aircraft control and stability augmentation systems are discussed with respect to the effects of atmospheric turbulence. The subjects presented include the following: (1) handling qualities requirements for flight in turbulence, (2) performance of unaugmented aircraft in turbulence, (3) performance of augmented aircraft in turbulence, and (4) approaches to stability augmentation systems development. Specific emphasis is placed on the aircraft parameters of planform, excitation derivatives, control power, and aircraft size. Author

**N74-17742\*** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.  
**THEORETICAL HORIZONTAL TAIL LOADS AND ASSOCIATED AIRCRAFT RESPONSES OF AN AUTOPILOT-CONTROLLED JET TRANSPORT FLYING IN TURBULENCE**  
Boyd Perry, III and Kermit G. Pratt /In AGARD Flight in Turbulence Nov. 1973 9 p refs

An exploratory analytical study was conducted to analyze problem areas associated with a rigid aircraft controlled by a simple autopilot. The aircraft motion is constrained to the longitudinal phugoid and short period modes. The autopilot characteristics are described. The analytical procedure is explained and stabilizer loads together with some aircraft motions as functions of autopilot gains within the stability boundaries are determined. The effects of center of gravity location and altitude are considered. Author

**N74-17743** Royal Aircraft Establishment, Farnborough (England). Avionics Dept.  
**THE DESIGN OF AUTOMATIC FLIGHT CONTROL SYSTEMS TO REDUCE THE EFFECTS OF ATMOSPHERIC DISTURBANCES**  
M. J. Corbin and K. F. Goddard /In AGARD Flight in Turbulence Nov. 1973 16 p refs

The design of two experimental automatic flight control systems for the BAC 111 aircraft is described. One system used throttle and elevator controls and the other uses, in addition, direct lift control by means of spoilers. The landing performance of the systems is compared with conventional automatic landing systems. It is stated that discrete gusts experienced at heights below 15 meters can produce large touchdown errors exceeding the capability of the autopilot control. Author

**N74-17744** Royal Aircraft Establishment, Bedford (England). Aero Flight Div.

**APPLICATION OF ENERGY MANAGEMENT CONCEPTS TO FLIGHT PATH CONTROL IN TURBULENCE**

J. G. Jones / In AGARD Flight in Turbulence Nov. 1973 18 p refs

Some effects of turbulence on aircraft flight path control are reviewed. An outline is presented of a strategy for the control of airspeed and flight path of an aircraft, based on the use of the throttle to control total energy error, consisting of a kinetic component associated with airspeed and a potential component associated with height, and the elevator used to distribute the energy error between airspeed and height in an optimum manner. Emphasis is placed on the flight path control in a landing approach. The safety aspects of an aircraft subjected to large gust disturbances are also considered. Author

**N74-17745** Office National d'Etudes et de Recherches Aérospatiales, Paris (France).

**A NEW APPROACH TO GUST ALLEVIATION OF A FLEXIBLE AIRCRAFT USING AN OPEN LOOP DEVICE**

Pierre-Marie Hutin / In AGARD Flight in Turbulence Nov. 1973 9 p ref In FRENCH; ENGLISH Summary

The application of optimization techniques for the purpose of gust alleviation is discussed. The basic approach is an extension of the Wiener's optimization theory to two control parameters and the application to the Caravelle aircraft. A comparison is made between the theoretical responses to a Gaussian stationary excitation and the responses to actual records of turbulence given by an analog computer taking into account the nonlinearities due to limited efficiency of the controls. Author

**N74-17747\*** Scientific Translation Service, Santa Barbara, Calif.

**EXPERIMENTAL STUDY OF A WING PROFILE WITH FOWLER FLAPS AND SLATS**

J. Barche Washington NASA Mar. 1974 38 p refs Transl. into ENGLISH from DFVLR Papers on Fluid Dyn. with Emphasis on Boundary Layer Theory, Pt. 1 (West Germany), 9 Mar. 1973 p 7-44

(Contract NASw-2483)  
(NASA-TT-F-15370; N73-33187) Avail: NTIS HC \$5.00 CSCL 01A

Usually high lift aids for aircraft are examined on scale-down models. The application of this experimental data is problematical. There is a basic interest in establishing a theory for the flow conditions over the flap system during takeoff and landing. The present experimental study attempts to provide the basis for future theoretical models based on detailed measurements over a simple profile which has Fowler flaps and slats. Author

**N74-17748** National Transportation Safety Board, Washington, D.C.

**AIRCRAFT ACCIDENT REPORT: OVERSEAS NATIONAL AIRWAYS, INC., MCDONNELL DOUGLAS, DC-8-63, N863F, BANGOR, MAINE, 20 JUNE 1973**

7 Feb. 1974 13 p  
(NTSB-AAR-74-1) Avail: NTIS HC \$4.00

A DC-8-63 en route from Tampa, Florida, to Geneva, Switzerland, via Bangor, Maine, and Amsterdam, the Netherlands, was involved in a takeoff accident at the Bangor International Airport, Bangor, Maine, on June 20, 1973. In the emergency evacuation that followed, 34 of the 251 passengers on board were injured. During the takeoff roll, the captain heard a loud,

muffled sound, like that of a blown tire, and discontinued the takeoff. A fire broke out in the right main landing gear assembly and right wing root area. The passengers and crew emerged via the airplane emergency escape chute system. The probable cause of the accident was the undetected deflation of a right main landing gear tire as the aircraft was taxiing for takeoff. The additional loads imposed upon two other tires caused them to fail during the takeoff roll. Subsequently, the wheel assemblies were damaged. The fire was ignited by the friction between the metal wheels and the runway pavement. Author

**N74-17749\*** Boeing Commercial Airplane Co., Seattle, Wash.  
**APPLICABILITY OF NASA (ARC) TWO-SEGMENT APPROACH PROCEDURES TO BOEING AIRCRAFT**

Robert L. Allison Jan. 1974 51 p refs  
(Contract NAS2-7561)  
(NASA-CR-114678; D6-41336) Avail: NTIS HC \$5.75 CSCL 01C

An engineering study to determine the feasibility of applying the NASA (ARC) two-segment approach procedures and avionics to the Boeing fleet of commercial jet transports is presented. This feasibility study is concerned with the speed/path control and systems compatibility aspects of the procedures. Path performance data are provided for representative Boeing 707/727/737/747 passenger models. Thrust margin requirements for speed/path control are analyzed for still air and shearing tailwind conditions. Certification of the two-segment equipment and possible effects on existing airplane certification are discussed. Operational restrictions on use of the procedures with current autothrottles and in icing or reported tailwind conditions are recommended. Using the NASA/UAL 727 procedures as a baseline, maximum upper glide slopes for representative 707/727/737/747 models are defined as a starting point for further study and/or flight evaluation programs. Author

**N74-17750\*** Boeing Commercial Airplane Co., Seattle, Wash.  
**HIGH TRANSONIC SPEED TRANSPORT AIRCRAFT STUDY**  
Final Report, Jun. 1972-May 1973

Robert M. Kulfan, Frank D. Neumann, James W. Nisbet, Alan R. Mulally, James K. Murakami, Elias C. Noble, John P. McBarron, James L. Stalter, David W. Gimmestad, and Mark B. Sussman Sep. 1973 205 p refs  
(Contract NAS2-7031)  
(NASA-CR-114658) Avail: NTIS HC \$13.25 CSCL 01C

An initial design study of high-transonic-speed transport aircraft has been completed. Five different design concepts were developed. These included fixed swept wing, variable-sweep wing, delta wing, double-fuselage yawed-wing, and single-fuselage yawed-wing aircraft. The boomless supersonic design objectives of range=5560 Km (3000 nmi), payload=18 143 kg (40 000 lb), Mach=1.2, and FAR Part 36 aircraft noise levels were achieved by the single-fuselage yawed-wing configuration with a gross weight of 211 828 Kg (467 000 lb). A noise level of 15 EPNdB below FAR Part 36 requirements was obtained with a gross weight increase to 226 796 Kg (500 000 lb). Although wing aeroelastic divergence was a primary design consideration for the yawed-wing concepts, the graphite-epoxy wings of this study were designed by critical gust and maneuver loads rather than by divergence requirements. The transonic nacelle drag is shown to be very sensitive to the nacelle installation. A six-degree-of-freedom dynamic stability analysis indicated that the control coordination and stability augmentation system would require more development than for a symmetrical airplane but is entirely feasible. A three-phase development plan is recommended to establish the full potential of the yawed-wing concept. Author

**N74-17751\*** Boeing Commercial Airplane Co., Seattle, Wash.  
**DESIGN INTEGRATION AND NOISE STUDIES FOR JET STOL AIRCRAFT. TASK 7A: AUGMENTOR WING CRUISE BLOWING VALVELESS SYSTEM. VOLUME 1: SYSTEM DESIGN AND TEST INTEGRATION**

F. A. Roepcke and T. B. Nickson Apr. 1973 47 p refs  
(Contract NAS2-6344)  
(NASA-CR-114621; D6-40950-Vol-1) Avail: NTIS HC \$5.50 CSCL 01C

Exploratory design studies conducted to establish the configuration of an augmentor wing cruise blowing (valveless) system in a 150-passenger STOL airplane were reported in NASA CR-114570. Those studies have been updated to incorporate the results of static rig, flow duct, and wind tunnel tests. Minor adjustments in duct flow velocity, flap length, and blowing nozzle geometry were incorporated to provide airplane characteristics that minimize takeoff gross weight and achieve sideline noise objectives for an advanced commercial STOL airplane. Author

**N74-17752\*#** Boeing Commercial Airplane Co., Seattle, Wash. **DESIGN INTEGRATION AND NOISE STUDIES FOR JET STOL AIRCRAFT. TASK 7C: AUGMENTOR WING CRUISE BLOWING VALVELESS SYSTEM. VOLUME 1: STATIC TESTING OF AUGMENTOR NOISE AND PERFORMANCE** J. M. Campbell, D. L. Harkonen, and J. V. O'Keefe Nov. 1973 45 p refs  
(Contract NAS2-6344)  
(NASA-CR-114622; D6-41216-Vol-1) Avail: NTIS HC \$5.25 CSCL 01C

Static performance and acoustic tests were conducted on a two-dimensional one-third-scale augmentor flap model that simulated a cruise blowing augmentor system designed for a scale augmentor flap model that simulated a cruise blowing augmentor, which offers a degree of 150-passenger STOL airplane. The cruise blowing augmentor, which offers a degree of simplicity by requiring no fan air diverter valves, was simulated by fitting existing lobe suppressor nozzles with new nozzle fairings. Flow turning performance of the cruise blowing augmentor was measured through a large range of flap deflection angles. The noise suppression characteristics of a multilayer acoustic lining installed in the augmentor were also measured. Author

**N74-17753\*#** Boeing Commercial Airplane Co., Seattle, Wash. **DESIGN INTEGRATION AND NOISE STUDIES FOR JET STOL AIRCRAFT. TASK 7C: AUGMENTOR WING CRUISE BLOWING VALVELESS SYSTEM. VOLUME 2: SMALL-SCALE DEVELOPMENT TESTING OF AUGMENTOR WING CRITICAL DUCTING COMPONENTS** J. N. Runnels and A. Gupta Nov. 1973 77 p refs  
(Contract NAS2-6344)  
(NASA-CR-114623; D6-40879-Vol-2) Avail: NTIS HC \$7.00 CSCL 01C

Augmentor wing ducting system studies conducted on a valveless system configuration that provides cruise thrust from the augmentor nozzles have shown that most of the duct system pressure loss would occur in the strut-wing duct y-junction and the wing duct-augmentor lobe nozzles. These components were selected for development testing over a range of duct Mach numbers and pressure ratios to provide a technical basis for predicting installed wing thrust loading and for evaluating design wing loading of a particular wing aspect ratios. The flow characteristics of ducting components with relatively high pressure loss coefficients were investigated. The turbulent pressure fluctuations associated with flows at high Mach numbers were analyzed to evaluate potential duct fatigue problems. Author

**N74-17754\*#** National Aeronautics and Space Administration. Mississippi Test Facility, Bay Saint Louis. **METHODS AND COSTS ASSOCIATED WITH OUTFITTING LIGHT AIRCRAFT FOR REMOTE SENSING APPLICATIONS** O. L. Rhodes and E. F. Zetka 4 Jul. 1973 73 p  
(NASA-TM-X-69938; ERL-076) Avail: NTIS HC \$6.75 CSCL 01C

This document was designed to provide the potential user of a light aircraft remote sensor platform/data gathering system with general information on aircraft definition, implementation complexity, costs, scheduling and operational factors involved in this type of activity. Most of the subject material was developed from actual situations and problem areas encountered during the build-up cycle and early phases of flight operations. Author

**N74-17755\*#** Boeing Commercial Airplane Co., Seattle, Wash. **A 727 AIRPLANE CENTER DUCT INLET LOW SPEED PERFORMANCE CONFIRMATION MODEL TEST FOR: REFANNED JT8D ENGINES, PHASE 2** G. Kaldschmidt, B. E. Syltebo, and C. T. Ting Nov. 1973 135 p refs  
(Contract NAS3-17842)  
(NASA-CR-134534; D6-41513) Avail: NTIS HC \$9.75 CSCL 01C

The results from testing of a 0.3 scale model center duct inlet (S duct) for the Pratt and Whitney Aircraft JT8D-100 engines are presented. The objective of this test was to demonstrate that the required airflow of the JT8D-100 engine (480 lb/sec as compared to 334 lb/sec for JT8D-15) can be achieved with minimum modifications to the existing 727 airplane structure at acceptable levels of total pressure recovery and distortion. Steady-state pressure recovery, steady-state pressure distortion, and dynamic pressure measurements were taken at the engine face station. Surface static pressure measurements were taken along the duct. Test results indicated that the required airflow was achieved with acceptable pressure recovery (comparable to the current 727-200 S duct). Inlet inflow angle variation within the 727 airplane operating regime (minus 5 to 5 degrees) had no effect on the inlet performance. Pressure distortion at static and forward speed at takeoff airflow conditions are within P and WA limits for the Phase II duct when equipped with vortex generators. Static crosswind operation between 10 knots and 25 knots appears feasible at full takeoff power. Author

**N74-17756\*#** Tennessee Univ. Space Inst., Tullahoma. **NOISE CHARACTERISTICS OF JET FLAP TYPE EXHAUST FLOWS Final Report** G. O. Schrecker and J. R. Maus Washington NASA Feb. 1974 135 p refs  
(Grant NGR-43-001-075)  
(NASA-CR-2342) Avail: NTIS HC \$4.75 CSCL 20A

An experimental investigation of the aerodynamic noise and flow field characteristics of internal-flow jet-augmented flap configurations (abbreviated by the term jet flap throughout the study) is presented. The first part is a parametric study of the influence of the Mach number (subsonic range only), the slot nozzle aspect ratio and the flap length on the overall radiated sound power and the spectral composition of the jet noise, as measured in a reverberation chamber. In the second part, mean and fluctuating velocity profiles, spectra of the fluctuating velocity and space correlograms were measured in the flow field of jet flaps by means of hot-wire anemometry. Using an expression derived by Lilley, an attempt was made to estimate the overall sound power radiated by the free mixing region that originates at the orifice of the slot nozzle (primary mixing region) relative to the overall sound power generated by the free mixing region that originates at the trailing edge of the flap (secondary mixing region). It is concluded that at least as much noise is generated in the secondary mixing region as in the primary mixing region. Furthermore, the noise generation of the primary mixing region appears to be unaffected by the presence of a flap. Author

**N74-17757\*#** Scientific Translation Service, Santa Barbara, Calif. **IMPROVEMENT OF MANEUVERABILITY AT HIGH SUBSONIC SPEEDS** W. Staudacher Washington NASA Mar. 1974 21 p refs  
Transl. into ENGLISH from the German report UFE-896-72  
(Contract NASw-2483)  
(NASA-TT-F-15406; UFE-896-72) Avail: NTIS HC \$4.25 CSCL 01C

Results of a series of experimental studies regarding the improvement of the maneuverability of fighter aircraft. The applicability of slotted and unslotted leading edge and trailing edge flaps was tested up to the transonic region on a wind tunnel model as a geometrically variable configuration variant. As a geometrically fixed configuration variant, strakes, or high sweepback leading edge modifications, were attached to the basic delta wing at the wing root and were tested in the entire Mach number range of a fighter aircraft. Through a combination of



the maneuver aids improvements of more than 100% over the basic wing could be achieved in certain flight ranges. The efficiency of the strake in the range of high angles of attack considerably exceeds that of the flap system. Author

**N74-17758\*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.  
**WIND TUNNEL INVESTIGATION OF SIMULATED HELICOPTER ENGINE EXHAUST INTERACTING WITH WIND-STREAM**

Craig S. Shaw and John C. Wilson Washington Mar. 1974 36 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va. Film Supplement Number L-1139 to this report is available on request from NASA. Langley Res. Center Attn: Photographic Branch, Mail Stop 171, Hampton, Va. 23665 (NASA-TM-X-3016; L-9430) Avail: NTIS HC \$3.25 CSCL 01C

A wind tunnel investigation of the windstream-engine exhaust flow interaction on a light observation helicopter model has been conducted in the Langley V/STOL tunnel. The investigation utilized flow visualization techniques to determine the cause to determine the cause of exhaust shield overheating during cruise and to find a means of eliminating the problem. Exhaust flow attachment to the exhaust shield during cruise was found to cause the overheating. Several flow-altering devices were evaluated to find a suitable way to correct the problem. A flow deflector located on the model cowl upstream of the exhaust in addition to aerodynamic shield fairings provided the best solution. Also evaluated was heat transfer concept employing pin fins to cool future exhaust hardware. The primary flow visualization technique used in the investigation was a newly developed system employing neutrally buoyant helium-filled bubbles. The resultant flow patterns were recorded on motion picture film and on television magnetic tape. Author

**N74-17759\*** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.  
**COMPUTED LATERAL POWER SPECTRAL DENSITY RESPONSE OF CONVENTIONAL AND STOL AIRPLANES TO RANDOM ATMOSPHERIC TURBULENCE**

Jacob H. Lichtenstein Washington Mar. 1974 90 p refs (NASA-TN-D-7444; L-9035) Avail: NTIS HC \$4.00 CSCL 01C

A method of computing the power spectral densities of the lateral response of airplanes to random atmospheric turbulence was adapted to an electronic digital computer. By use of this program, the power spectral densities of the lateral roll, yaw, and sideslip angular displacement of several conventional and STOL airplanes were computed. The results show that for the conventional airplanes, the roll response is more prominent than that for yaw or sideslip response. For the STOL airplanes, on the other hand, the yaw and sideslip responses were larger than the roll response. The response frequency of the STOL airplanes generally is higher than that for the conventional airplanes. This combination of greater sensitivity of the STOL airplanes in yaw and sideslip and the frequency at which they occur could be a factor causing the poor riding qualities of this class of airplanes. Author

**N74-17760#** Centre d'Essai Aeronautique, Toulouse (France).  
**LABORATORY SIMULATION OF KINETIC HEATING EFFECTS ON THE STRUCTURE OF CONCORDE AIRCRAFT [RESTITUTION EN LABORATOIRE DES EFFETS DE L'ECHAUFFEMENT CINETIQUE SUR LA STRUCTURE DE L'AVION CONCORDE]**

M. Perrais 1973 18 p In FRENCH Presented at the Intern. Colloq. Simulation and Space, Toulouse, 10-14 Sep. 1973 Avail: NTIS HC \$4.00

The kinetic heating effects on the Concorde aircraft structure were simulated by means of an infrared radiation facility. The simulation of convection flux effects by radiation flux poses a problem in that the radiation flux is practically unaffected by surface temperature, whereas the convection flux is. The radiation flux is therefore adapted to the surface as a function

of the required temperature by subdividing the surface in heating zones on which a group of IR tubes radiates equal fluxes at given moments. For the Concorde structure 150 such groups were utilized. The thermal stress results obtained were compared to inflight stresses, and good concordance was found. ESRO

**N74-17761#** Air Force Flight Dynamics Lab., Wright-Patterson AFB, Ohio.

**TWO DIMENSIONAL AIR CUSHION LANDING SYSTEM PERIPHERAL JET CONFIRMATION STUDY M.S. Thesis - AF Inst. of Tech.**

John R. Rogers Sep. 1973 101 p refs (AF Proj. 1369) (AD-771616; GAM/AE/73-13; AFFDL-TR-73-5) Avail: NTIS CSCL 01/3

A simplified two-dimensional peripheral jet theory for the equilibrium performance of an air cushion vehicle is investigated. The proposed theory intends to yield a rapid prediction of the actual flow rate and actual power requirements for an air cushion landing system in the hover condition. Nine specific nozzle configurations were tested to determine which resulted in the best power-height performance and whether the theory is able to predict the experimental performance. Three single peripheral jet configurations were tested at a trunk pressure of 80 psfg. Six distributed jet configurations were tested at a trunk pressure of 40 psfg. Effects of inward flow injection angles of 30 degrees and 60 degrees were investigated. (Modified author abstract) GRA

**N74-17762#** Human Factors Research, Inc., Goleta, Calif.  
**COLOR PERCEPTION IN THE TRANSITIONAL ZONES OF TRICOLOR GLIDE-SLOPE INDICATORS (GSI'S) Technical Report, 29 Jun. - 29 Nov. 1973**

Robert T. Hennessy and Gail J. Borden Nov. 1973 66 p refs (Contract N00156-73-C-1008) (AD-771422; Rept-1751) Avail: NTIS CSCL 01/2

The report describes an investigation of color perception in the transitional zones of tricolor glide-slope indicators (GSI's) designed to aid helicopter night approaches to non-aviation ships. In GSI's with colors arranged, from top to bottom, yellow, green, red (YGR), an anomalous yellow or white appears in the transitional zones between the green and red color regions. This anomalous color can be misinterpreted as a too high signal and lead to a potentially hazardous descent maneuver. It was experimentally determined that the anomalous color zone occurs over an angular extent of at least .319 degrees in the GSI unit tested. (Modified author abstract) GRA

**N74-17763#** Army Aviation Systems Test Activity, Edwards AFB, Calif.

**INSTRUMENTATION SPECIFICATION FOR CLIMATIC LABORATORY TESTS**

Kenneth R. Ferrell and Thomas L. Lynch Aug. 1973 10 p (AD-771053; USAASTA-73-41) Avail: NTIS CSCL 01/3

The specification defines the test instrumentation requirements for Climatic Laboratory tests conducted by the United States Army Aviation Systems Test Activity (USAASTA). This document is intended to provide guidance to contractors and activities that are required to instrument and support Climatic Laboratory tests conducted at Eglin Air Force Base, Florida. GRA

**N74-17764#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**DYNAMIC MODEL WIND TUNNEL TESTS OF A VARIABLE-DIAMETER, TELESCOPING-BLADE ROTOR SYSTEM (TRAC ROTOR)**

Evan A. Fradenburgh, Robert J. Murrill, and Edmond F. Kiely Jul. 1973 217 p refs (Contract DAAJ02-68-C-0074; DA Proj. 1F1-62204-A-139) (AD-771037; SER-50797; USAAMRDL-TR-73-32) Avail: NTIS CSCL 01/3

An analytical and experimental program was conducted to establish feasibility and determine characteristics of the Sikorsky TRAC rotor system, which is a unique variable-diameter, telescoping-blade concept for advanced rotary-wing aircraft. The

program included a preliminary design study of a full-scale blade, wind tunnel tests of a dynamically scaled rotor model in various flight modes, and correlation of experimental results with theory. Feasibility was established for the TRAC rotor operating both as a high-speed compound helicopter and as a stopped/stowed rotor configuration. The basic blade structural design and the retraction system were verified with the model, which was scaled for operation at full tip speeds and forward speeds. (Modified author abstract) GRA

**N74-17765#** AiResearch Mfg. Co., Torrance, Calif.  
**MECHANICAL COMPONENT FAILURE PROGNOSIS STUDY**  
**Final Report**

Hans K. Ziebarth, Jee-Da Chang, and Joseph Kukul Jun. 1973  
 103 p refs  
 (Contract DAAJ02-71-C-0049; DA Proj. 1F1-62203-A-434)  
 (AD-771033; Rept-72-8745; USAAMRDL-TR-73-26) Avail:  
 NTIS CSCL 01/3

The report presents the results of a study of failure prognosis of mechanical components of propulsive transmissions and gearboxes of Army aircraft. The step from on-line determination of component current mechanical condition by inferential, or diagnostic, methods to condition prognosis appears feasible if diagnostic techniques of the signature-composite interpretive type are used and diagnostic information is blended with inputs from the areas of component design theory, tribology, system abnormal physiology, and life predictive theory. For current component status determination, use of dynamic and lubricant-carried particle content signatures was found to be of greatest value. Use of the composite exceedance method in the dynamic data interpretation area and use of statistical methods recently developed in fluid-borne particle metrology in the lubricant particle content area would be indicated for attaining prognostic objectives.

Author (GRA)

**N74-17766#** Ketron, Inc., Wayne, Pa.  
**INTEGRATED MAINTENANCE AND READINESS DATA**  
**PROCESSING FOR THE CASEE SIMULATION MODEL** Final  
**Report**

William A. Meroney and Michael G. Temple 15 Aug. 1973  
 26 p refs  
 (Contract N62269-72-C-0924)  
 (AD-771416; KTR-655-1) Avail: NTIS CSCL 01/3

The document describes, and gives user instructions for, two programs developed by KETRON to provide aircraft readiness and part availability data for the CASEE simulation model. These programs have been developed and tested on a CDC 6600 with 64K words of core. They are coded in FORTRAN 4, with the exception of COMPASS subroutines used to read the 3-M MAF and READY tapes. Conversion of the FORTRAN code to a programming environment where these tapes could be read directly in FORTRAN (e.g., IBM System 360 OS), would eliminate the need for the assembly language subroutines. Author (GRA)

**N74-17767#** AeroVironment, Inc., Pasadena, Calif.  
**AIRCRAFT VORTEX WAKE DESCENT AND DECAY UNDER**  
**REAL ATMOSPHERIC EFFECTS** Final Report, Sep. 1972 -  
 Feb. 1973

P. B. S. Lissaman, S. C. Crow, P. B. MacCready, Jr., I. H. Tombach, and E. R. Bate, Jr. Oct. 1973 211 p refs Sponsored in part by Transportation Sys. Center  
 (AD-771311; TSC-FAA-73-20) Avail: NTIS CSCL 01/1

Aircraft vortex wake descent and decay in a real atmosphere is studied analytically. Factors relating to encounter hazard, wake generation, wake descent and stability, and atmospheric dynamics are considered. Operational equations for encounter hazard, wake generation, and atmospheric dynamics are given, including a brief description of a possible automatic meteorological system to provide atmospheric data for an airport wake forecasting program. A new analysis for Crow instability in ambient turbulence is given, expressing time-to-linkage as an explicit function of the turbulent dissipation. GRA

**N74-17769#** Environmental Protection Agency, Washington, D.C. Office of Noise Abatement and Control.

**IMPACT CHARACTERIZATION OF NOISE INCLUDING**  
**IMPLICATIONS OF IDENTIFYING AND ACHIEVING LEVELS**  
**OF CUMULATIVE NOISE EXPOSURE** Final Report

27 Jul. 1973 296 p refs  
 (PB-224408/5GA; EPA-NTID73.4) Avail: NTIS HC \$6.50 CSCL 06S

An extensive task force effort to gather all available data pertinent to impact characterization of noise including implications of identifying and achieving levels of cumulative noise exposure is discussed. GRA

**N74-17770#** Environmental Protection Agency, Washington, D.C. Office of Noise Abatement and Control.

**REVIEW AND ANALYSIS OF PRESENT AND PLANNED FAA**  
**NOISE REGULATORY ACTIONS AND THEIR CONSEQUENCES**  
**REGARDING AIRCRAFT AND AIRPORT OPERATIONS** Final Report

27 Jul. 1973 183 p  
 (PB-224405/1GA; EPA-NTID73.6) Avail: NTIS HC \$5.25 CSCL 01E

The report is a result of an extensive task force effort to gather all available data pertinent to review and analysis of present and planned FAA noise regulatory actions and their consequences regarding aircraft and airport operations. It represents the interpretation of such data by the task group chairman responsible for this specific report. It does not necessarily reflect the official views of EPA and does not constitute a standard, specification or regulation. GRA

**N74-17771#** Environmental Protection Agency, Research Triangle Park, N.C. Task Group 4.

**NOISE SOURCE ABATEMENT TECHNOLOGY AND COST**  
**ANALYSIS INCLUDING RETROFITTING** Final Report

William C. Sperry 27 Jul. 1973 303 p refs  
 (PB-224422/6GA; EPA-NTID73.5) Avail: NTIS HC \$7.00 CSCL 01C

The report is a result of an extensive task force effort to gather all available data pertinent to noise source abatement technology and cost analysis including retrofitting. It represents the interpretation of such data by the task group chairman responsible for this specific report. It does not necessarily reflect the official views of EPA and does not constitute a standard, specification or regulation. Author (GRA)

**N74-17772#** Whittaker Corp., San Diego, Calif. Research and Development Div.

**COMPOSITE-MATERIAL HELICOPTER ROTOR HUBS** Final  
**Technical Report, Mar. 1971 - Nov. 1972**

B. Levenetz Jul. 1973 253 p refs  
 (Contract DAAJ02-71-C-0032; DA Proj. 1F1-62208-A-170)  
 (AD-771973; MJO-3027; USAAMRDL-TR-73-14) Avail: NTIS CSCL 01/3

The report describes the development work for construction of helicopter rotor hubs from fibrous composite materials. The prototype hubs were designed to be structurally and functionally equivalent to the metallic hub used on the Sikorsky CH-54B helicopter. The design is based on the principle of filament-wound tension loops in combination with laminated shear panels. The report contains a description of the design elements, of the structural analysis, of the construction methods, and of the experimental evaluation of rotor hubs subjected to static as well as cyclic loads. Design and construction problems are discussed, and the potential of the composite hub concept is outlined. (Modified author abstract) GRA

**N74-17773#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**THE EVALUATION OF A STALL-FLUTTER SPRING-DAMPER**  
**PUSHROD IN THE ROTATING CONTROL SYSTEM OF A**  
**CH-54B HELICOPTER** Final Report

David O. Adams Aug. 1973 104 p refs  
 (Contract DAAJ02-71-C-0058)

(AD-771962; SER-64372; USAAMRDL-TR-73-55) Avail: NTIS CSCL 01/3

The report describes a program conducted to evaluate the effect of rotating control system damping on stall-induced control loads and on aircraft handling qualities in stall. Such damping was introduced in the CH-54B control system by replacing the standard pushrods by a spring-damper assembly. The CH-54B helicopter was chosen as the test vehicle because it exhibits stall-induced loads. Dynamic analyses defined pushrod stiffness and damping characteristics required to reduce the high-frequency torsional response of the main rotor blades. Spring-damper pushrods exhibiting the desired characteristics were designed, fabricated, and laboratory tested to assure that design requirements were met. The spring-damper pushrods were installed on a test rotor head and tested on the Sikorsky main rotor whirl tower. (Modified author abstract) GRA

**N74-17774#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**AEROELASTIC ANALYSIS OF A TELESCOPING ROTOR BLADE Final Report**

Raymond G. Carlson and Sebastian J. Cassarino Aug. 1973 122 p refs

(Contract DAAJ02-72-C-0025; DA Proj. 1F1-63204-D-157) (AD-771963; USAAMRDL-TR-73-48) Avail: NTIS CSCL 01/3

Two computer programs were developed to evaluate the aeroelastic response of a telescoping rotor blade (TRAC). The first program calculates the uncoupled blade natural frequencies for flatwise, edgewise, and torsional degrees of freedom. The second program is a forced-response program and is a modification of the computer program provided to the Army under Contract DAAJ02-71-C-0024. It calculates the time history of the response of either a single blade or the complete rotor on a rigid-body airframe. Both steady-state and transient response can be analyzed. The forced-response program uses blade mode shapes and natural frequencies calculated from the natural frequency program. The mathematical model used reflects the unique structure of the TRAC blade, which consists of torque tube, outboard blade, jackscrew, and two tension straps. (Modified author abstract) GRA

**N74-17775#** Electro Development Corp., Lynwood, Wash. **HELICOPTER GROSS WEIGHT AND CENTER OF GRAVITY MEASUREMENT SYSTEM Final Report**

Richard L. Dybvad Aug. 1973 76 p refs  
(Contracts DAAJ02-71-C-0029; DAAJ02-72-C-0053; DA Proj. 1F1-62205-A-529)

(AD-771955; USAAMRDL-TR-73-66) Avail: NTIS CSCL 01/3

The design of an on-board gross weight and center of gravity measurement system applicable to the CH-47 and UH-1 helicopters was developed, and a prototype CH-47 system was evaluated in the laboratory. Gross weight accuracies of plus or minus 1.6% of maximum design weight were achieved in a laboratory simulation of the environment. A flightworthy prototype was subsequently fabricated and evaluated in flight tests on a CH-47 helicopter at the U.S. Army Aviation Systems Test Activity, Edwards AFB, California. The results show accuracies of plus or minus 1% full scale with the helicopter in a rotors-static condition. With rotors-in-motion, however, errors up to 5000 lb occurred in the gross weight due to the inaccuracy of the rotor lift measurement. It is concluded that the method of measuring rotor lift via rotor structural stresses is viable, but further investigation is required into the nature of the thermal stresses and dynamic forces induced by hot lubricants and pitch actuator cylinder. Author (GRA)

**N74-17776#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div. **TAKE-OFF VELOCITIES**

M. Rozenblat 28 Nov. 1973 12 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 5, May 1973 p 26-27

(AD-771632; FTD-HT-23-534-74) Avail: NTIS CSCL 01/3

In the last 10-15 years the aeronautical engineering characteristics of cargo aircraft have changed considerably. There has been a sharp increase in the ranges of possible flight velocities and flying weights and flight safety requirements have been raised. However, the method of using aerodynamic corrections to the velocity indicator retained a number of tolerances which were valid earlier. Under modern conditions these tolerances lead to considerable errors in information on flight velocity under certain important flight modes, in particular under the conditions of take-off. GRA

**N74-17778#** Army Foreign Science and Technology Center, Charlottesville, Va.

**AIR MOBILE TECHNICAL MAINTENANCE UNIT**

V. Yurev 16 Nov. 1973 6 p Transl. into ENGLISH from Aviat. Kosmonavt. (Moscow), no. 1, 1972 p 22

(AD-771786; FSTC-HT-23-2102-72) Avail: NTIS CSCL 01/3

The report describes a typical maintenance facility and maintenance problems extant in a Soviet helicopter unit. GRA

**N74-17779#** Battelle Columbus Labs., Ohio.

**GENERAL AVIATION COST IMPACT STUDY. VOLUME 1: EXECUTIVE SUMMARY Final Report**

J. W. Chadwick, T. W. Hall, E. T. Yeager, and R. W. Cote Jun. 1973 36 p refs

(Contract DOT-FA72WA-3118)

(AD-771603) Avail: NTIS CSCL 01/3

The report in four volumes presents the results of an analysis of the effects of cost changes on general aviation activity. The major objectives of the study were to investigate ownership and operating costs in each segment of general aviation, and to develop methodology for evaluating the cost impact of regulatory changes on general aviation activity. The study effort included compilation of a cost and activity data base, definition of fixed and variable cost centers, determination of cost sensitivity relationships and determination of cost impact relationships. Volume 1 provides a summary of the overall study. (Modified author abstract) GRA

**N74-17780#** Battelle Columbus Labs., Ohio.

**GENERAL AVIATION COST IMPACT STUDY. VOLUME 2: RESEARCH METHODOLOGY Final Report**

J. W. Chadwick, T. W. Hall, E. T. Yeager, and R. W. Cote Jun. 1973 133 p

(Contract DOT-FA72WA-3118)

(AD-771606) Avail: NTIS CSCL 01/3

The report in four volumes presents the results of an analysis of the effects of cost changes on general aviation activity. Volume 2 presents the rationale and methodology used in the analysis. (Modified author abstract) GRA

**N74-17781#** Battelle Columbus Labs., Ohio.

**GENERAL AVIATION COST IMPACT STUDY. VOLUME 3: PLANNING GUIDE Final Report**

J. W. Chadwick, T. W. Hall, E. T. Yeager, and R. W. Cote Jun. 1973 218 p

(Contract DOT-FA72WA-3118)

(AD-771759) Avail: NTIS CSCL 01/3

The report in four volumes presents the results of an analysis of the effects of cost changes on general aviation activity. The major objectives of the study were to investigate ownership and operating costs in each segment of general aviation, and to develop methodology for evaluating the cost impact of regulatory changes on general aviation activity. The study effort included compilation of a cost and activity data base, definition of fixed and variable cost centers, determination of cost sensitivity relationships and determination of cost impact relationships. The results are presented in graphical form in Volume 3 of this report to facilitate easy use. (Modified author abstract) GRA

**N74-17782#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CLIMBING PERFORMANCE**

S. Skripnichenko 30 Nov. 1973 12 p Transl. into ENGLISH from Grazhdanskaya Aviatsiya (Moscow), no. 7, Jun. 1973 p 24-25

(AD-772052; FTD-HT-23-538-74) Avail: NTIS CSCL 01/2

The report develops an optimum climbing attitude for commercial aircraft to obtain a maximum climb rate using a safe and economical procedure. GRA

**N74-17783#** Army Materiel Systems Analysis Agency, Aberdeen Proving Ground, Md.

**HELICOPTER WEIGHT, SIZE, AND PERFORMANCE PROGRAM**

George W. Koch Jun. 1973 60 p refs

(DA Proj. 1T6-65706-M-541)

(AD-771140; AMSAA-TR-65) Avail: NTIS CSCL 01/3

The report portrays an analysis method which was developed for determining the weight, size, and performance of helicopters. The analysis method was programmed in FORTRAN 4 for use on a high speed digital computer (BRLESC). The program was specifically developed for trending and comparison purposes. There are sixteen helicopter characteristics, such as, speed, range, payload, disc loading, blade solidity, passive defense features, etc., which can be varied in order to give insight into their effects on the weight, size, and performance of helicopters. All of the characteristics are coordinated so that the effect of them on each other can be examined in context. Author (GRA)

**N74-17799#** Edo Corp., College Point, N.Y. Government Products Div.

**EXPERIMENTAL REEL RESPONSE SYSTEM FOR HIGH PERFORMANCE SIMPLIFIED AERIAL REFUELING STORE**  
Final Engineering Report

R. J. Miko, L. Pino, and H. Schwartz Apr. 1973 56 p

(Contract N00019-70-C-0498)

(AD-771389; EDO-9972) Avail: NTIS CSCL 01/2

The report presents the results of a program to verify the feasibility of innovations to a high performance aerial refueling store designed under a previous contract. Operational tests of an experimental hose reel assembly and control system demonstrated the simplicity of system operation and control. The test program demonstrated that the hydrostatic transmission and controls could achieve the desired hose extension, response and retraction accelerations and velocities, and that the hose could be wound onto a 17-inch diameter reel positioned with its axis parallel to the store centerline. Author (GRA)

**N74-17893#** Forschungsinstitut fuer Hochfrequenzphysik, Wuerthhoven (West Germany).

**FURTHER MEASUREMENTS ON SATELLITE LINK FADING AT LOW ALTITUDES ABOVE IRREGULAR TERRAIN**

J. Hertenbach Oct. 1973 22 p refs Reprinted from Proc. 16th Symp. on Tactical Satellite Commun. (The Hague) 19 Sep. 1973 p 25-43

(Contract T-0230-92320-91345)

(Rept-4-73) Avail: NTIS HC \$4.25

Fading characteristics of low altitude helicopter to satellite links were measured. Data evaluation comprises level crossing rates, probability distribution functions, average duration of fades, and envelope spectra for horizontal and vertical polarization. Some phenomena typical for low altitudes are described. ESRO

**N74-17902#** Naval Electronics Lab. Center, San Diego, Calif.  
**FIBER AND INTEGRATED OPTIC COMMUNICATION TECHNOLOGY** Research and Development Report, 1 Oct. 1972 - 31 Mar. 1973

W. E. Martin and D. J. Albares 24 Aug. 1973 42 p refs

(ARPA Order 2158)

(AD-771402; NELC-TR-1891) Avail: NTIS CSCL 17/2

Applications assessment studies and a preliminary cost-benefit analysis are performed which indicate areas of definite performance gains and cost savings from use of fiber-optic and integrated-optical-circuit (IOC) technologies, particularly in avionics systems. Progress in fiber optics, which has made possible the use of conventional off-the-shelf components in proposed systems with immediate applications, is shown. Progress is also shown in IOC technology, particularly in modulators for use in proposed

high-bandwidth systems. Several unique IOC devices are investigated which promise to have the capability to use extremely-wide-bandwidth optical waveguides. Author (GRA)

**N74-17909\*#** Stanford Research Inst., Menlo Park, Calif.

**DESIGN OF A FAULT TOLERANT AIRBORNE DIGITAL COMPUTER. VOLUME 1: ARCHITECTURE** Final Report

J. H. Wensley, K. N. Levitt, M. W. Green, J. Goldberg, and P. G. Neumann Oct. 1973 187 p refs

(NASA-CR-132252) Avail: NTIS HC \$12.50 CSCL 09B

This volume is concerned with the architecture of a fault tolerant digital computer for an advanced commercial aircraft. All of the computations of the aircraft, including those presently carried out by analogue techniques, are to be carried out in this digital computer. Among the important qualities of the computer are the following: (1) The capacity is to be matched to the aircraft environment. (2) The reliability is to be selectively matched to the criticality and deadline requirements of each of the computations. (3) The system is to be readily expandable, contractible, and (4) The design is to appropriate to post 1975 technology. Three candidate architectures are discussed and assessed in terms of the above qualities. Of the three candidates, a newly conceived architecture, Software Implemented Fault Tolerance (SIFT), provides the best match to the above qualities. In addition SIFT is particularly simple and believable. The other candidates, Bus Checker System (BUCS), also newly conceived in this project, and the Hopkins multiprocessor are potentially more efficient than SIFT in the use of redundancy, but otherwise are not as attractive. Author

**N74-17921#** Air Force Armament Lab., Eglin AFB, Fla.

**USERS MANUAL FOR STICM (THE STODOLA IN-CORE MATRIX): AN IN-CORE MATRIX OPERATIONS COMPUTER PROGRAM** Final Report, Mar. 1970 - Jan. 1971

Robert W. Bunton Sep. 1973 40 p ref

(AF Proj. 2567)

(AD-770999; AFATL-TR-73-186) Avail: NTIS CSCL 09/2

The Stodola In-Core Matrix (STICM) operator is an in-core matrix manipulation computer program which uses a modified STodola method to solve for real eigensolutions. The basic input concepts and many of the matrix operations in STICM are borrowed from the random MATrix Operations (MATOP) program but STICM is specifically tailored to perform aircraft vibrations on a production basis. Author (GRA)

**N74-17926#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**CALCULATION OF CERTAIN GEOMETRIC PARAMETERS OF COMPLEX SURFACES ON URAL-4 COMPUTER**

S. M. Zamalin 10 Dec. 1973 20 p refs Transl. into ENGLISH from Samolektostr. Tekh. Vozdush. Flota (USSR), no. 25, 1971 p 61-69

(AD-772040; FTD-HT-23-180-74) Avail: NTIS CSCL 09/2

When calculating and reproducing the external shapes of aircraft, it is necessary to solve a large number of geometric problems. The paper presents computer applications to these geometric problems. GRA

**N74-17958\*#** Scientific Translation Service, Santa Barbara, Calif.

**CONCERNING THE PERFORMANCE DATA OF A REVERBERATION CHAMBER**

K. Niwa, S. Aramaki, and Y. Nagasawa Washington NASA Mar. 1974 11 p ref Transl. into ENGLISH from Koku Igaku Jikkentai Hokoku (Tokyo), v. 8, no. 1-2, Sep. 1967 p 54-59 (Contract NASw-2483)

(NASA-TT-F-15371) Avail: NTIS HC \$4.00 CSCL 14B

The characteristics of a reverberation chamber designed for investigating the physiological effects of aircraft noise are discussed. An OS-620 type noise field generator was used as the sound source. The equipment for measuring the reverberation time is described. The sound pressure distribution inside the chamber was measured by drawing lines in radial form from the center of the room to the corners and the centers of the

walls. Measurements were taken at one meter intervals along the lines. Author

**N74-17959\*# Hydronautics, Inc., Laurel, Md.  
MODEL EXPERIMENTS TO EVALUATE VORTEX DISSIPATION DEVICES PROPOSED FOR INSTALLATION ON OR NEAR AIRCRAFT RUNWAYS**

Robert E. Kohl Aug. 1973 116 p refs  
(Contract NAS1-11389)  
(NASA-CR-132365) Avail: NTIS HC \$9.00 CSCL 13B  
The effectiveness of various vortex dissipation devices proposed for installation on or near aircraft runways is evaluated on basis of results of experiments conducted with a 0.03-scale model of a Boeing 747 transport aircraft in conjunction with a simulated runway. The test variables included type of vortex dissipation device, mode of operation of the powered devices, and altitude, lift coefficient and speed of the generating aircraft. A total of fifteen devices was investigated. The evaluation is based on time sequence photographs taken in the vertical and horizontal planes during each run. Author

**N74-17960\*# Boeing Commercial Airplane Co., Seattle, Wash.  
DESIGN AND FABRICATION OF AN AUGMENTOR WING MODEL FOR ACOUSTIC TESTS**

John Jackson, R. W. Schedin, and J. M. Campbell, Dec. 1973 102 p ref  
(Contract NAS3-17362)  
(NASA-CR-134518; D6-41465) Avail: NTIS HC \$8.25 CSCL 14B

The design and fabrication of a full-scale section of an augmentor wing to be used for acoustic testing at the Lewis Research Center are discussed. This hardware will be used primarily to investigate scaling effects of acoustic data obtained during the Boeing-run model tests. Typical model test data is shown in the report, together with predictions on both performance and acoustics that can be expected from the full-scale section to be built. Areas covered include: the aerodynamic and acoustic criteria of the flap system and nozzles, detailed discussion of the hardware, test system operation procedure, and stress analysis of the entire test system. Author

**N74-17961# Kernforschungsanlage, Juelich (West Germany).  
Inst. fuer Physikalische Chemie.  
ACCLIMATIZED WIND TRACK FOR MEASUREMENT OF OXYGEN ISOTOPE FRACTIONATION IN ISOLATED LEAVES AND IN LEAF MODELS**

W. Hotopp and H. Foerstel May 1973 45 p refs In GERMAN; ENGLISH summary  
(JUL-949-PC) Avail: AEC Depository Libraries HC \$4.25

The planning and layout of a small wind track in which fixed climatic conditions can be adjusted are presented. The facility was designed for model investigations concerning the oxygen isotope fractionation of fluid water exchanging with the water vapor of streaming air. Further measurements are planned to investigate the O-18 isotope enrichment within the leaf water of land plants. The wind track was built as a closed system. Wind velocities can be controlled between 0.5 and 3.5 m/sec within a temperature range of 5 to 35 C and the humidity can be controlled between 20 and 90%. With these data it is possible to simulate normal environmental conditions for land plants. Author (NSA)

**N74-17963# Army Engineer Waterways Experiment Station,  
Vicksburg, Miss.**

**DEVELOPMENT OF MINIMUM PIPE COVER REQUIREMENTS FOR C-5A AND OTHER AIRCRAFT LOADINGS Final Report, Jun. 1970 - Jun. 1972**

Charles C. Calhoun, Jr. and Harry H. Ulery, Jr. Nov. 1973 131 p refs  
(DA Proj. 4A0-62203-A-859)  
(AD-771174; AEWES-Misc-Paper-S-73-65) Avail: NTIS CSCL 01/5

The investigation was conducted to develop structural requirements (minimum cover tables) for buried pipe beneath flexible- and rigid-pavement, landing-mat-surfaced, and unsurfaced

airfields subject to operations of the C-5A and other aircraft in the theater of operations. Present design practices were reviewed, and computer programs based on the present design practices were written and used to predict pipe behavior under various loadings. Stress-at-depth data from full-scale load cart tests, field surveys, and tests of pipe subjected to the C-5A and other loadings were analyzed, and the field behavior was compared with predicted behavior. Minimum pipe-cover requirements were developed for rigid and flexible pipe buried beneath airfields to be subjected to operations of the C-5A and other aircraft. (Modified author abstract) GRA

**N74-17983# Admiralty Research Lab., Teddington (England).  
USE OF TWO-DIMENSIONAL UNSTEADY FLOW THEORY WITH LOW ASPECT-RATIO BLADES**

M. T. Murray May 1973 15 p refs  
(ARL/M/N-17; BR37049; N-1/3.85) Avail: NTIS HC \$4.00

It is known that if two-dimensional aerofoil theory is used to calculate the mean forces on a marine propeller blade, the answer obtained is likely to over-estimate the true answer by a factor of typically three. It is shown that when unsteady forces (at shaft-rate or blade-rate) are being calculated, the use of unsteady two-dimensional aerofoil theory is much more acceptable, being associated with errors of about 60% for shaft-rate forces and 25% for blade-rate forces. It is pointed out that the more accurate unsteady lifting-surface theory is prohibitively expensive for use regularly as a design tool, and further, that the accuracy of the answer may be limited in any case by the accuracy of the measured wake data. Author (ESRO)

**N74-18083# Radio Corp. of America, Burlington, Mass.  
HOLOGRAPHIC MULTICOLOR MOVING MAP DISPLAY (SYSTEM DEFINITION) Final Report**

Gardner T. Burton, Burton R. Clay, Richard F. Croce, Douglas A. Gore, Louis A. Perretta, B. W. Siryl, and R. C. Blanchard Sep. 1973 135 p  
(Contract N62269-72-C-0452)  
(AD-772155) Avail: NTIS CSCL 09/5

The report describes the work performed during a 12-month program designed to extend the performance characteristics of a holographic moving map display concept to enhance its performance characteristics in a cockpit environment. Features were added to the basic display concept to allow use of the moving map concept as a horizontal situation display. Techniques were presented for adding dynamic symbology features to the display for preflight annotating of the displayed data, and for presenting IR, FLIR and LLTV information through the same viewing aperture as the map data. A new transport system was defined to access the stored data rapidly. Author (GRA)

**N74-18096\*# Bowles Fluidics Corp., Silver Spring, Md.  
THE FEASIBILITY OF A FLUIDIC RESPIRATORY FLOW METER Final Report, 27 Sep. 1972 - 11 Jan. 1974**

Vincent F. Neradka and Harry C. Bray, Jr. Jan. 1974 44 p refs  
(Contract NAS1-11955)  
(NASA-CR-132296; R-01-09-74) Avail: NTIS HC \$5.25 CSCL 14B

A study was undertaken to determine the feasibility of adapting a fluidic airspeed sensor for use as a respiratory flowmeter. A Pulmonary Function Testing Flowmeter was developed which should prove useful for mass screening applications. The fluidic sensor threshold level was not reduced sufficiently to permit its adaptation to measuring the low respiratory flow rates encountered in many respiratory disorders. Author

**N74-18097# Solar, San Diego, Calif.  
TURBINE BLADE TEMPERATURE MEASUREMENT SYSTEM: OPERATION MANUAL**

David A. Rohy and W. A. Compton Oct. 1973 34 p  
(SOLAR-P/N-106751) Avail: NTIS HC \$4.75

Turbine blade temperature control is described for engines

operating with inlet gas temperatures over 2000 F. A description of the turbine blade temperature measurement system is given in an operator's manual. Calibration procedures, engineering drawings and schematics are included. S.K.W.

**N74-18145#** Summa Corp., Culver City, Calif. Helicopters Div.

**DEVELOPMENT OF A LOW-COST COMPOSITE DIE USING HIGH-ENERGY-RATE FORMING (HERF) Final Report**

Gordon K. Dingle and Joseph E. Leach, Jr. Nov. 1973 .51 p (Contract DAAG46-73-C-0028)  
(AD-771957; HH-73-76; AMMRC-CTR-73-43) Avail: NTIS CSCL 13/9

A program was conducted to design, fabricate, and test/evaluate a low-cost composite die system for high-energy-rate forming (HERF) of titanium and high-temperature alloy parts commonly used on helicopters. The composite die design was evaluated by conducting forming operations on seven pieces of 321 stainless steel and eight pieces of 6Al-4V titanium alloy. The composite die met the design objectives of low cost (half that of conventional dies), short lead time (at least half that of conventional dies), and medium life (500 cycles). (Modified author abstract) GRA

**N74-18146#** Franklin Inst. Research Labs., Philadelphia, Pa. **INVESTIGATION OF SLIDING-SURFACE BEARINGS OF SCREW PUMPS UTILIZED ON THE NAVY DISTILLATE FUEL OIL CONVERSION PROGRAM Final Report, Nov. 1972 Sep. 1973**

Harry C. Rippel, Iqbal M. Anwar, and Wilbur Shapiro Dec. 1973 286 p  
(Contract N00014-69-C-0055)

(AD-771453; FIRL-I-C2429-5) Avail: NTIS CSCL 13/9

The report describes the evaluation of IMO pumps used in Naval fuel oil systems. Conversion to distillate fuels resulted in high failure rates due to poor lubrication and high fuel contamination. The effort primarily concentrated on the analytical study of the bearings when using NSFO and distillate-type fuels, i.e., ND, DFM and JP-5. The analytical approach developed allows evaluation of bearing performance when the mode of the bearing operation is either full-film hydrodynamic or mixed film. With regard to the mixed-film evaluation, the criterion of boundary friction energy density was selected. This criterion is a measure of bearing distress as provided by the product of metal-to-metal contact friction force per unit area times sliding velocity. Forty different pump models belonging to five different pump series were evaluated. (Modified author abstract) GRA

**N74-18183#** Dow Chemical Co., Midland, Mich.

**MAGNESIUM-YTTRIUM ALLOYS, SCALE-UP AND EVALUATION Final Report**

Bruce C. Peters and Sidney L. Couling Apr. 1973 97 p refs  
(Contract DAAG11-69-C-0626)

(AD-771039) Avail: NTIS CSCL 11/6

A magnesium alloy containing 9% yttrium, 1% zinc, and 0.5% zirconium was produced in the form of sheet and extrusions on production equipment and the resulting materials were then evaluated for structural performance. The measured room temperature strength properties of the sheet and extrusions were very high for a magnesium alloy. It was demonstrated that the sheet and extrusions can be fabricated into structural shapes and assemblies without undue difficulty. The projection was confirmed of a 21% weight reduction for a helicopter tail cone by switching certain components from aluminum to magnesium. The magnesium-yttrium panels, however, when tested to fracture, demonstrated little warning of impending rupture and it was concluded that this material was not acceptable for use in primary aircraft structures. (Modified author abstract) GRA

**N74-18280#** Army Electronics Command, Fort Monmouth, N.J.

**FOG CLEARING USING HELICOPTER DOWNDRAFTS: A NUMERICAL MODEL**

Walter S. Nordquist, Jr. Dec. 1973 73 p refs

(DA Proj. 1T0-61102-B-53A)

(AD-771038; ECOM-5527) Avail: NTIS CSCL 04/2

A one-dimensional parameterized numerical model is presented which depicts the physical conditions attendant with the use of helicopter downdrafts for the creation of temporary clearings in fog. The results generated by the numerical model are compared to the data available from helicopter downdraft experiments. An example is given of the application of the model for investigation of the utility of the helicopter downdraft fog clearing technique for a particular set of meteorological conditions. Author (GRA)

**N74-18312#** Defense Documentation Center, Alexandria, Va. **ENVIRONMENTAL POLLUTION: AIR POLLUTION (EXHAUST GASES) Report Bibliography, Jan. 1971 Jul. 1973**

Dec. 1973 94 p refs

(AD-771710; DDC-TAS-73-77) Avail: NTIS CSCL 13/3

The bibliography comprises citations of unclassified reports dealing with exhaust gases in a series of bibliographies on air pollution. Topics discussed include air pollution from exhaust gases emanating from ground and air transportation. There are also included some references to exhaust systems of jet engines, helicopters, turbojet engines, and rocket motors. Corporate Author-Monitoring Agency, Subject, Title, Personal Author, Contract, and Report Number Indexes are included. Author (GRA)

**N74-18315#** OST/FAA Flight Service Station Evaluation Team, Washington, D.C.

**A PROPOSAL FOR THE FUTURE OF FLIGHT SERVICE STATIONS. VOLUME 1: SUMMARY Final Report**

Aug. 1973 73 p

(PB-225052/OGA) Avail: NTIS HC \$3.50 HC also available from NTIS \$11.00/set of 5 reports as PB-225051-SET CSCL 17G

A brief FSS program history is presented and the problem is defined. Present system costs, system user descriptions, evaluation methodology, functional recommendations, proposed automated system, concept description and costs, manpower estimates, implementation concept, and funding requirements are summarized. An appendix containing the letters received from user organizations pertaining to the report is included. Author (GRA)

**N74-18316#** OST/FAA Flight Service Station Evaluation Team, Washington, D.C.

**A PROPOSAL FOR THE FUTURE OF FLIGHT SERVICE STATIONS. VOLUME 2: COST ANALYSIS OF THE PRESENT FLIGHT SERVICE STATION SYSTEM Final Report**

Aug. 1973 34 p refs

(PB-225053/8GA) Avail: NTIS HC \$3.00 HC also available from NTIS \$11.00/set of 5 reports as PB-225051-SET CSCL 17G

Total costs of the present FSS system are developed and allocated among the major functions performed. Unit service costs are derived. Total costs are extrapolated to determine the expense of expanding the present system (without changes in the mode of operation) to meet the projected 1983 demand. Author (GRA)

**N74-18317#** OST/FAA Flight Service Station Evaluation Team, Washington, D.C.

**A PROPOSAL FOR THE FUTURE OF FLIGHT SERVICE STATIONS. VOLUME 3: FUNCTIONAL ANALYSIS OF THE FSS SYSTEM Final Report**

Aug. 1973 47 p

(PB-225054/6GA) Avail: NTIS HC \$3.00 HC also available from NTIS \$11.00/set of 5 reports as PB-225051-SET CSCL 17G

The major FSS functions are analyzed from the perspectives of benefits and beneficiaries, primary purpose and components of each function, alternate approaches, and the impacts of

continuing of eliminating each. Recommendations are made to continue eight functions and transfer or eliminate four.

Author (GRA)

**N74-18318#** OST/FAA Flight Service Station Evaluation Team, Washington, D.C.

**A PROPOSAL FOR THE FUTURE OF FLIGHT SERVICE STATIONS. VOLUME 4: PROPOSED AUTOMATED FSS SYSTEM CONCEPT Final Report**

Aug. 1973 62 p refs  
(PB-225055/3GA) Avail: NTIS HC \$3.50 HC also available from NTIS \$11.00/set of 5 reports as PB-225051-SET CSDL 17G

The proposed automated FSS system concept is described, requirements for system sizing and configuration to meet 1983 forecast demand are developed, hardware and software configurations are detailed to the extent necessary for system cost estimates, and staffing requirements are derived. Author (GRA)

**N74-18319#** OST/FAA Flight Service Station Evaluation Team, Washington, D.C.

**A PROPOSAL FOR THE FUTURE OF FLIGHT SERVICE STATIONS. VOLUME 5: IMPLEMENTATION CONCEPT FOR THE PROPOSED SYSTEM Final Report**

Aug. 1973 27 p  
(PB-225056/1GA) Avail: NTIS HC \$3.00 HC also available from NTIS \$11.00/set of 5 reports as PB-225051-SET CSDL 17G

An implementation concept and schedule is presented for the gradual transition from the current system to the proposed. Implementation objectives are developed, facilities and equipment projects are described along with funding requirements, engineering and development considerations are summarized, and manpower requirements are estimated. Author (GRA)

**N74-18397\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

**ANALOG COMPUTER IMPLEMENTATION OF FOUR INSTANTANEOUS DISTORTION INDICES**

William G. Costakis Washington Mar. 1974 32 p refs  
(NASA-TM-X-2993; E-7736) Avail: NTIS HC \$3.25 CSDL 21E

Dynamic distortion data obtained from inlet engine compatibility test on a J85-GE-13 engine are used to establish the feasibility of using on-line generated indices as control signals. These data are analyzed over time increments of 1.3 seconds on an analog computer. The analog program of four instantaneous distortion indices and their results are presented. A modified approach in determining the extent of distortion is also presented. Author

**N74-18399\*#** Massachusetts Inst. of Tech., Cambridge. Aeroelastic and Structures Research Lab.

**EXPERIMENTAL AND DATA ANALYSIS TECHNIQUES FOR DEDUCING COLLISION-INDUCED FORCES FROM PHOTOGRAPHIC HISTORIES OF ENGINE ROTOR FRAGMENT IMPACT/INTERACTION WITH A CONTAINMENT RING**

Raffi P. Yeghiayan, John W. Leech, and Emmett A. Witmer Oct. 1973 100 p refs  
(Grant NGR-22-009-339)

(NASA-CR-134548; ASRL-TR-154-5) Avail: NTIS HC \$8.00 CSDL 21E

An analysis method termed TEJ-JET is described whereby measured transient elastic and inelastic deformations of an engine-rotor fragment-impacted structural ring are analyzed to deduce the transient external forces experienced by that ring as a result of fragment impact and interaction with the ring. Although the theoretical feasibility of the TEJ-JET concept was established, its practical feasibility when utilizing experimental measurements of limited precision and accuracy remains to be established. The experimental equipment and the techniques (high-speed motion photography) employed to measure the transient deformations of fragment-impacted rings are described. Sources of error and data uncertainties are identified. Techniques employed to reduce data reading uncertainties and to correct the data for optical-

distortion effects are discussed. These procedures, including spatial smoothing of the deformed ring shape by Fourier series and timewise smoothing by Gram polynomials, are applied illustratively to recent measurements involving the impact of a single T58 turbine rotor blade against an aluminum containment ring. Plausible predictions of the fragment-ring impact/interaction forces are obtained by one branch of this TEJ-JET method; however, a second branch of this method, which provides an independent estimate of these forces, remains to be evaluated. Author

**N74-18400\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

**FORECAST OF JET ENGINE EXHAUST EMISSIONS FOR FUTURE HIGH ALTITUDE COMMERCIAL AIRCRAFT**

Jack Grobman and Robert D. Ingebo 1974 34 p refs Presented at 3rd Conf. on Climatic Impact Assessment Program, Cambridge, Mass., 26 Feb. - 1 Mar. 1974  
(NASA-TM-X-71509; E-7822) Avail: NTIS HC \$4.75 CSDL 21E

Projected minimum levels of engine exhaust emissions that may be practicably achievable for future commercial aircraft operating at high altitude cruise conditions are presented. The forecasts are based on: (1) current knowledge of emission characteristics of combustors and augmentors; (2) the current status of combustion research in emission reduction technology; (3) predictable trends in combustion systems and operating conditions as required for projected engine designs that are candidates for advanced subsonic or supersonic commercial aircraft. Results are presented for cruise conditions in terms of an emission index, g pollutant/kg fuel. Two sets of engine exhaust emission predictions are presented: the first, based on an independent NASA study and the second, based on the consensus of an ad hoc committee composed of industry, university, and government representatives. The consensus forecasts are in general agreement with the NASA forecasts. Author

**N74-18405#** Colt Industries, Inc., West Hartford, Conn. Chandler Evans Control Systems Div.

**TURBINE ENGINE FUEL CONTROL RELIABILITY AND MAINTAINABILITY ANALYSIS Final Report, 30 Jun. 1972 - 31 Mar. 1973**

Dennis G. Burnell, Terry B. Morrison, and Albert H. White Aug. 1973 161 p refs  
(Contract DAAJ02-72-C-0110; DA Proj. 1F1-62205-A-119)  
(AD-771030; R-673-9; USAAMRDL-TR-73-60) Avail: NTIS CSDL 21/5

The report was undertaken to establish cost-effective recommendations for improving the design life and maintainability of Army gas turbine engine fuel control systems. Army experience indicates that problems with the fuel control account for 10 to 13% of the engine malfunctions and that 30 to 50% of the fuel control removals are unjustified. Data collected during the study indicates that failure modes common to the majority of all present-day fuel controls account for about 25% of the control removals. These failure modes included susceptibility to air and fuel contamination, fuel seal leaks, wear of drive splines, and improper adjustments. (Modified author abstract) GRA

**N74-18416#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**AIRCRAFT AIR INTAKE REGULATOR**

V. V. Sarev, B. G. Turbin, M. Ya. Goldman, and Yu. S. Belkin 28 Nov. 1973 6 p Transl. into ENGLISH from Russian Patent no. 342815, 22 Jun. 1972 p 1-2  
(AF Proj. G101)

(AD-772021; FTD-HT-23-815-74) Avail: NTIS CSDL 21/5

The report describes a Soviet invention of a device whereby the air intake of aircraft engines is automatically regulated. GRA

**N74-18417#** Systems Research Labs., Inc., Dayton, Ohio.  
**INVESTIGATION IN ENERGY TRANSFER AND ENERGY CONVERSION FOR ADVANCED POWER AND PROPULSION**

**SYSTEMS Final Report, 16 Mar. 1970 - 16 Mar. 1973**

C. Calvert and J. Watson Oct. 1973 120 p refs  
(Contract F33615-70-C-1515; AF Proj. 7116)  
(AD-771581; ARL-73-0122) Avail: NTIS CSCL 10/2

The report covers the work done in three areas of energy conversion and transfer involving fluid dynamic processes: electrofluiddynamic energy conversion, multicomponent flow research, and aerodynamic energy transfer research. The effort under item one was an exploration of direct energy conversion of fluid dynamic energy into electrical power using electrofluid-dynamic (EFD) processes. The objective here was to identify workable and practical processes and designs for superior, lightweight, reliable, electrical generators. Item two covers studies of methods by which heat energy from reactions of solid particles or droplets contained in a combustion or reaction chamber can be used to produce fluid dynamic energy. The principal objective of this work was to assess wall erosion, particle suspension, and related fluid dynamic processes and components germane to practical thrust augmentation ejectors. The objective was to identify appropriate design concepts applicable to future vertical or short-field take-off-and-landing aircraft. (Modified author abstract) GRA

**N74-18549#** Forest Products Lab., Madison, Wis.

**DESIGN PARAMETERS FOR TORSION OF SANDWICH STRIPS HAVING TRAPEZOIDAL, RECTANGULAR, AND TRIANGULAR CROSS SECTIONS**

H. M. Montrey and Edward W. Kuenzi 1973 37 p refs  
Revised

(AD-771824; FSRP-FPL-156-Rev) Avail: NTIS CSCL 01/3

Solutions for elastic torsion of sandwich strips with triangular, rectangular, or trapezoidal cross sections are presented as suitable design parameters. Author (GRA)

**N74-18606#** RAND Corp., Santa Monica, Calif.

**THE POTENTIAL FOR ENERGY CONSERVATION IN COMMERCIAL AIR TRANSPORT**

James J. Mutch Oct. 1973 90 p refs  
(Grant NSF GI-44)

(R-1360-NSF) Avail: NTIS HC \$7.50

The potential is examined for reducing the energy requirements of the U.S. commercial airlines, with emphasis on the certificated-route air carriers. Measures stressed are independent of the level of traffic demand. They are intended to reduce energy requirements by decreasing the energy intensity of air transport. The possibility is examined of substituting more efficient transport modes for aviation in short-haul routes and the attendant net energy savings is assessed. Measures that yield benefits in both the short and long term are considered and their conservation potentials are quantified relative to present and future energy requirements. The results should be of interest to those involved in airline activities, including governmental regulatory and policymaking bodies, industry groups, and the airlines themselves. Author

**N74-18607#** RAND Corp., Santa Monica, Calif.

**TRANSPORTATION ENERGY USE IN THE UNITED STATES: A STATISTICAL HISTORY, 1955 - 1971**

James J. Mutch Dec. 1973 54 p refs  
(Grant NSF GI-44)

(R-1391-NSF) Avail: NTIS HC \$5.75

Total transportation energy consumption is considered in view of increased travel per person and an increasing use of more energy intensive modes. Energy distribution for modes and markets is shown from 55 to 71 in graphical form. Freight and passenger transportation on highways, aircraft, railroads, and waterways are also reviewed. J.A.M.

**N74-18611#** Deutsche Forschungs- und Versuchsanstalt fuer Luft- und Raumfahrt, Porz (West Germany).

**ANNUAL REPORT, 1972 [JAHRESBERICHT, 1972]**

1972 479 p refs IN GERMAN

Avail: NTIS HC \$27.00

Theoretical and experimental research work is reported in the areas of: Fluid mechanics; Aeronautical engineering and flight control; Structural materials, hardness, and construction methods;

Energy and propulsion; Electronics; Aerospace physics, space simulation, aerospace medicine; Computer techniques; Aeronautical technology; and Space flight projects. Transl. by G.G.

**N74-18627#** RAND Corp., Santa Monica, Calif.

**COMPARISONS OF SOVIET AND US TECHNOLOGY**

Robert Perry Jun. 1973 49 p refs

(Contract F44620-73-C-0011)

(AD-771004; R-827-PR) Avail: NTIS CSCL 05/1

The military sector of Soviet R and D may be more efficient than the civilian sector; and in some respects, particularly in aircraft development, the Soviet military R and D system appears to be more efficient than U.S. military R and D. One consequence is that the U.S.S.R. seems capable of generating more system options at lower costs and presumably with less risk than the U.S. in the present system acquisition environment. A second finding of this study is embodied in the demonstration that the extent of Soviet technological advancement can be ascertained for one specialized regime of military technology--turbine engines, in this instance--and the methodology developed in that demonstration can be applied to several areas of technology. Even if there is uncertainty about some of the underlying data, military goods and services should be expressed in terms that uniformly reflect Soviet rather than U.S. manufacturing methods and input quantities. Author (GRA)

**N74-18637#** McDonnell-Douglas 'Astronautics' Co., St. Louis, Mo.

**FORWARD AIR CONTROLLER: TACTICAL AIR COMMAND PILOT COMMUNICATION ORIENTATION Final Technical Report**

P. B. DeVries, Jr. and J. I. Laveson 30 Aug. 1973 86 p refs  
(Contract F44620-72-C-0068; AF Proj. 9778)

(AD-771071; MDC-E0888; AFOSR-73-1994TR) Avail: NTIS CSCL 17/8

The overall objective of the research was to determine if a standardized lexicon of terrain features could be of benefit to Forward Air Controllers (FACs) and Tactical Strike Pilots (TACs) in target acquisition operations. Sixty experienced pilots were asked to view aerial photographs of 21 different terrain features, and to state what they would call each feature and list characteristics of each. There were five major research objectives: Review of the scientific literature pertinent to FAC-TAC communication orientation, the experimental determination of the most commonly used terrain descriptors, development of a standardized lexicon, an evaluation of the performance of aircraft pilots using the derived lexicon, and a separate effort to determine the applicability of the theory of 'signal' detection to real-time perceptual problems of FAC-TAC operations. GRA

**N74-18640#** Army Natick Labs., Mass.

**CONCEPT FOR A MULTIPLE PERSONNEL AIRDROP SYSTEM**

James F. Falcone Nov. 1973 22 p ref  
(DA Proj. 1F1-62203-A-33A)

(AD-771945; USA-NLABS-TR-74-15-AD) Avail: NTIS CSCL 15/7

In order to achieve significant improvement in the Army's airdrop capabilities, unconventional and even radical concepts along with more sophisticated techniques must be considered. One valid concept for reduction of dispersion employs multiple exit of troops from the aircraft. This can be accomplished by use of a container or structure which will deliver a squad size, or larger, fighting unit completely equipped and ready for immediate action upon landing. A particular configuration of a multiple personnel airdrop system is described in detail along with some suggested variations and options of the basic concept. (Modified author abstract) GRA

**N74-18642** Texas A&M Univ., College Station.

**A NUMERICAL VORTEX BOX TECHNIQUE FOR CALCULATIONS IN LIFTING SURFACE THEORY Ph.D. Thesis**

Garry Owen Hawkins 1973 216 p

Avail: Univ. Microfilms Order No. 74-1013



3. The method derives its working form directly from the physical interpretation of the basic equation from which all solutions in subsonic wing theory are developed. The method is formulated for both the two and three-dimensional cases, with the working form generated from comparisons with the known exact value for a flat plate at incidence. Results are generated in the three-dimensional case for rectangular wings and swept wings of various aspect ratios. The general conclusion is reached that the method compares very well with the known exact solution in the two-dimensional case and with the various solutions in the three-dimensional case. The present method is physically justifiable due to the fact that it is obtained directly from the general equation of wing theory. Dissert. Abstr.

**N74-18643** Ohio State Univ., Columbus.  
**STUDY OF THE ELECTROSTATIC FIELD AND CHARGE DISTRIBUTION IN A VORTEX SEEDED WITH DUST** Ph.D. Thesis

John William Daugherty 1973 354 p  
 Avail: Univ. Microfilms Order No. 73-26795

An experimental program was undertaken to investigate the vortex geometry, particle distribution and electric field distribution in a trailing vortex shed from an airfoil tip placed in a dust laden flow. A differential airfoil, positioned in a subsonic wind tunnel, generated the trailing vortex. Dust conditions, typical of a helicopter landing zone, were simulated by seeding the wind tunnel flow with P.V.C. plastic pellets, no. 3 sand, and no. 120 sand. An airbearing vortex probe was designed and constructed for use in measuring the vortex geometry. The probe was calibrated over a range from 0 to 12,000 R.P.M. The airbearing vortex probe was found to be unaffected by free stream conditions. A particle impact probe and a miniature field meter were used to map the particle distribution and electric field distribution across the trailing vortex. Vortex geometry particle distribution and electric field intensity were measured throughout the plane normal to the wind tunnel axis at several locations downstream from the airfoil. Dissert. Abstr.

**N74-18644#** Grumman Aerospace Corp., Bethpage, N.Y. Research Dept.

**IMPLICIT MODEL DECOUPLING APPROACH TO VTOL FLIGHT CONTROL DESIGN**

David Rothschild and Eliezer Kreindler (Technion, Israel Inst. of Tech., Haifa) Jan. 1974 39 p refs  
 (RE-469) Avail: NTIS HC \$5.00

The results of a preliminary study to determine the feasibility of applying a flight control design technique based on linear optimal control for decoupling the longitudinal dynamic modes of a VTOL jet at low speed and hover are presented. To alleviate the pilot's task of maintaining a stable attitude, or carrying out specific types of maneuvers at critically low speeds, the design objective formulated is to provide the pilot with only three controls with which to maneuver the vehicle independently in pitch angle and forward and normal velocities. The implicit model following approach was employed to synthesize the feedback and feedforward gain solutions corresponding to various levels of handling quality performance and control authority limitations.

Author

**N74-18645#** United Aircraft Corp., East Hartford, Conn. Research Labs.

**EXPERIMENTAL INVESTIGATION OF MODEL VARIABLE GEOMETRY AND OGEE TIP ROTORS** Final Report

Anton J. Landgrebe and E. Dean Bellinger Washington NASA Feb. 1974 114 p refs

(Contract NAS1-10906)  
 (NASA-CR-2275) Avail: NTIS HC \$4.50 CSCL 01A

An experimental investigation was conducted to systematically explore the effects of inter-blade spatial relationships and pitch variations on rotor performance and wake geometry. Variable-geometry rotors consisting of various combinations of blade length, axial spacing, azimuth spacing, and collective pitch were tested at model scale in hover and forward flight. In addition, a hover test of a model rotor with an ogee blade tip design was conducted to determine its performance and wake characteristics. The results

of this investigation indicate that properly selected variable geometry rotor configurations can offer substantial improvements in hover performance without adversely affecting forward flight performance. Axial spacing of alternate blades was found to provide the greatest performance benefit, and further improvements were achieved by combining azimuth spacing with axial spacing. The performance benefit appears to be related to the relief of local adverse aerodynamic phenomena produced by vortex interference. The ogee tip design was found to substantially reduce the concentrated core intensity of the tip vortex, and could thus prove beneficial for the relief of blade-vortex interaction problems. However, the ogee tip was found to reduce hover performance at model scale. Author

**N74-18646#** Avco Corp., Wilmington, Mass. Systems Div.  
**INVESTIGATION OF NONLINEAR INVISCID AND VISCOUS FLOW EFFECTS IN THE ANALYSIS OF DYNAMIC STALL** Final Report

Peter Crimi Washington NASA Feb. 1974 114 p refs  
 (Contract NAS1-11245)

(NASA-CR-2335) Avail: NTIS HC \$4.50 CSCL 01A

A method for analyzing unsteady airfoil stall was refined by including nonlinear effects in the representation of the inviscid flow. Certain other aspects of the potential-flow model were reexamined and the effects of varying Reynolds number on stall characteristics were investigated. Refinement of the formulation improved the representation of the flow and chordwise pressure distribution below stall, but substantial quantitative differences between computed and measured results are still evident for sinusoidal pitching through stall. Agreement is substantially improved by assuming the growth rate of the dead-air region at the onset of leading-edge stall is of the order of the component of the free stream normal to the airfoil chordline. The method predicts the expected increase in the resistance to stalling with increasing Reynolds number. Results indicate that a given airfoil can undergo both trailing-edge and leading-edge stall under unsteady conditions. Author

**N74-18648#** Aerospace Corp., El Segundo, Calif.

**AN EXPERIMENTAL STUDY OF THE VALIDITY OF THE HEAT-FIELD CONCEPT FOR SONIC-BOOM ALLEVIATION** Final Report

Rudolph J. Swigart Washington NASA Mar. 1974 80 p refs

(Contract NAS1-10051)  
 (NASA-CR-2381; ATR-74(7218)-1) Avail: NTIS HC \$4.00 CSCL 01A

An experimental program was carried out in the NASA-Langley 4 ft x 4 ft supersonic pressure tunnel to investigate the validity of the heat-field concept for sonic boom alleviation. The concept involves heating the flow about a supersonic aircraft in such a manner as to obtain an increase in effective aircraft length and yield an effective aircraft shape that will result in a shock-free pressure signature on the ground. First, a basic body-of-revolution representing an SST configuration with its lift equivalence in volume was tested to provide a baseline pressure signature. Second, a model having a 5/2-power area distribution which, according to theory, should yield a linear pressure rise with no front shock wave was tested. Third, the concept of providing the 5/2-power area distribution by using an off-axis slender fin below the basic body was investigated. Then a substantial portion (approximately 40 percent) of the solid fin was replaced by a heat field generated by passing heated nitrogen through the rear of the fin. Author

**N74-18649#** Aircraft Research Association, Ltd., Bedford (England).

**THE EFFECT OF MILD REAR FUSELAGE UPSWEEP ON REAR FUSELAGE LOADS AND PRESSURE DISTRIBUTIONS FOR A SWEEP WING-BODY COMBINATION AT SUBSONIC SPEEDS**

D. Morton Mar. 1974 22 p  
 (Contract KC/49/15)  
 (ARA-34) Avail: NTIS HC \$4.25

Tests were made over the range 0.5 much smaller than M much smaller than 0.9 to determine the effect of rear fuselage upsweep typical of an airbus aircraft, on the loads and pressure distributions on the rear fuselage. The drag due to upsweep increased with M and decreased with increase of alpha. The upsweep reduced the drag for alpha larger than 4 deg at M = 0.5. At a typical cruise condition the drag penalty due to upsweep would be about 2% of the total aircraft drag. The measured pressures on the symmetrical rear fuselage along upper and lower center lines show good agreement with those calculated by inviscid potential flow theory on an equivalent axisymmetric body. Author

**N74-18653#** Advisory Group for Aerospace Research and Development, Paris (France).

**ON THE PREDICTION OF AERODYNAMIC LOADS ON OSCILLATING WINGS IN TRANSONIC FLOW**

H. Tijdeman (Natl. Aerospace Lab., Amsterdam) and R. J. Zwaan (Natl. Aerospace Lab., Amsterdam) Jan. 1974 30 p refs Presented at 36th AGARD Structures and Mater. Panel Meeting, Milan, 4 Apr. 1973

(AGARD-R-612) Avail: NTIS HC \$4.50

Possibilities to develop calculation methods for oscillating wings in transonic flow are discussed. Special attention is given to the question of linearization. Pressure measurements on an aerofoil with flap in transonic flow are analyzed. Correlations are made between steady, quasi-steady and unsteady results. Shock motion and shock strength are investigated. Also linearity is discussed. A calculation method for high subsonic flow is suggested. Author

**N74-18654#** Advisory Group for Aerospace Research and Development, Paris (France).

**INTERFERING LIFTING SURFACES IN UNSTEADY SUBSONIC FLOW: COMPARISON BETWEEN THEORY AND EXPERIMENT**

Juergen Becker (Messerschmitt-Boelkow-Blohm, Munich) Jan. 1974 20 p refs Presented at 37th AGARD Structures and Mater. Panel Meeting, the Hague, 7-12 Apr. 1973 (AGARD-R-614) Avail: NTIS HC \$4.00

The results of experimental and analytical research work on the flutter with complete aircraft models showed considerable shifting of critical flutter speeds due to interfering aerodynamic forces, particularly where models of variable geometry were concerned. This was the reason for the development of aerodynamic interference procedures for two or more oscillating surfaces. In order to calculate interfering aerodynamic forces, theoretical procedures were developed which may be divided into lifting surface theories and double lattice methods. Measurements of unsteady pressure distributions on a variable wing-tail configuration, were compared with the results of the lifting surface theory. Author

**N74-18655#** Aeronautical Research Labs., Melbourne (Australia).

**FORTRAN PROGRAMS FOR THE DETERMINATION OF GENERALISED AIR FORCES ON INTERFERING LIFTING SURFACES OSCILLATING IN SUBSONIC FLOW**

P. A. Farrell Aug. 1973 83 p refs (ARL/SM-Rept-345) Avail: NTIS HC \$7.25

The unsteady aerodynamic forces by the oscillating motion of a wing are analyzed. The wing is idealized as a thin flat plate oscillating in a potential flow. A modification of the doublet lattice theory has been programmed to calculate the unsteady, generalized aerodynamic forces acting on interfering lifting surfaces in subsonic flow. An outline of the relevant theory is given. The limitations and usage of the computer programs are described. Results are compared with those of other theoretical methods. Author

**N74-18656#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

**WIND TUNNEL BLOCKAGE AND SUPPORT INTERFERENCE EFFECTS ON WINGED-BODY MODELS AT MACH NUM-**

**BERS FROM 0.6 TO 1.0**

Bernard J. Blaha Washington Mar. 1974 36 p refs (NASA-TM-X-3011; E-7596) Avail: NTIS HC \$3.25 CSCL 01A

Three sting-mounted winged-body models with tunnel blockages of 0.1, 1.0, and 2.0 percent were tested in the Lewis Research Center's 8- by 6- Foot Supersonic Wind Tunnel. Fuselage pressures were obtained over a Mach number range of 0.6 to 1.0 at angles of attack from 0 deg to 4 deg. Two other types of model support were investigated, which included simulated wing-tip and fuselage support-strut mountings. The effects of tunnel porosity and sidewall geometry were also investigated. Model blockage effects were small up to M sub 0 = 0.95. At higher speeds the major blockage effect observed was a displacement of the local transonic terminal shocks on the model. The effects of the wing-tip type of model support were small up to M sub 0 = 0.95, but disturbances were observed on the fuselage at higher speeds. Changes in local tunnel porosity were effective in reducing the disturbances up to M sub 0 = 0.975, but a change in sidewall geometry was not. Author

**N74-18657#** National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

**FLIGHT-TEST INVESTIGATION OF THE AERODYNAMIC CHARACTERISTICS AND FLOW INTERFERENCE EFFECTS ABOUT THE AFT FUSELAGE OF THE F-111A AIRPLANE**

Norman V. Taillon Washington Feb. 1974 77 p refs (NASA-TN-D-7563; H-717) Avail: NTIS HC \$4.00. CSCL 01A

Static pressure measurements were made on the aft fuselage of an F-111A airplane to determine local flow characteristics and engine/airframe interaction effects. Data were obtained over the Mach number range from 0.5 to 2.0. Aspiration effects associated with low ejector nozzle expansion ratios reduced the local pressure coefficients particularly on the interfairing but also extending to the trailing edge of the nacelle. The presence of afterbodies also affected the behavior of the air flowing into and about the ejector nozzle. Pressures about the aft fuselage were improved by an increase in primary nozzle area at a supersonic speed. A comparison of wind-tunnel and flight-test results showed generally good agreement, although there was a large disparity in pressure level about the ejector nozzle. However, the shape of the data curves and the local flow behavior were basically similar. Author

**N74-18658#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

**PRESSURE DISTRIBUTION ON A VECTORED-THRUST V/STOL FIGHTER IN THE TRANSITION-SPEED RANGE**

Raymond E. Mineck and Richard J. Margason Washington Mar. 1974 398 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va. (NASA-TM-X-2867; L-8975) Avail: NTIS HC \$8.25 CSCL 01A

A wind-tunnel investigation has been conducted in the Langley V/STOL tunnel with a vectored-thrust V/STOL fighter configuration to obtain detailed pressure measurements on the body and on the wing in the transition-speed range. The vectored-thrust jet exhaust induced a region of negative pressure coefficients on the lower surface of the wing and on the bottom of the fuselage. The location of the jet exhaust relative to the wing was a major factor in determining the extent of the region of negative pressure coefficients. Author

**N74-18662#** Royal Aircraft Establishment, Farnborough (England). Aerodynamics Dept.

**A SUGGESTION FOR IMPROVING FLAP EFFECTIVENESS BY HEAT ADDITION**

J. Martin London ARC 1973 53 p refs Supersedes RAE-TR-72002; ARC-33876 (ARC-CP-1252; RAE-TR-72002; ARC-33876) Avail: NTIS HC \$5.75; HMSO 85p; PHI \$3.55

The effect of heat addition on the flow around a two dimensional flapped airfoil section, at low Mach number, is

investigated using a transformation. This enables the compressible flow with heat addition to be deduced from incompressible flow with fluid addition. The incompressible flow may be determined by the technique of conformal mapping. It is concluded that heat addition in a suitable distribution can so reduce the adverse pressure gradient on the upper surface of the flap that greater flap angles than are normally possible can be employed without separation of the boundary layer. The result is an increase in lift. The effect is illustrated for a flapped air-foil section of convenient mathematical form. Author (ESRO)

**N74-18663#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

**A TECHNIQUE FOR MEASURING OSCILLATORY AERODYNAMIC CONTROL SURFACE HINGE MOMENTS FROM FORCED RESPONSE CHARACTERISTICS**

D. R. Gaukroger, D. A. Drane, and R. Gray London ARC 1973 38 p refs Supersedes RAE-TR-71211; ARC-33869 (ARC-CP-1253; RAE-TR-71211; ARC-33869) Avail: NTIS HC \$5.00; HMSO 60p; PHI \$2.55

A technique for measuring the hinge moment aerodynamic derivatives for an oscillating control surface is described. The technique is identical to that used in the measurement of subcritical response of flutter models, except that the model under test is nominally rigid, and the only designed motion is rotation of the control surface. Test results are given for a full-span control surface on a slightly swept wing. The Mach number range was from  $M = 0.6$  to  $M = 1.2$ , and the Reynolds number range from 0.7 to 2.7 million, based on wing mean chord.

Author (ESRO)

**N74-18665#** National Physical Lab., Teddington (England). Aerodynamics Div.

**NPL 9615 AND NACA 0012: A COMPARISON OF AERODYNAMIC DATA**

N. Gregory and P. G. Wilby London ARC 1973 51 p refs Supersedes ARC-30657; NPL-AERO-SR-017 (ARC-CP-1261; ARC-30657; NPL-AERO-SR-017) Avail: NTIS HC \$5.75; HMSO 80p; PHI \$3.35

Ordinates, surface slopes, and curvatures are listed for the two airfoils together with a detailed tabulation of lift, drag, and pitching moment data obtained at Mach numbers between 0.3 and 0.85 in the NPL 36 in. x 14 in. transonic tunnel. The aerodynamic characteristics and all pressure distribution are plotted, with some comparisons. Author (ESRO)

**N74-18666#** National Physical Lab., Teddington (England). Aerodynamics Div.

**AERODYNAMIC CHARACTERISTICS OF NPL 9626 AND NPL 9627, FURTHER AEROFOILS DESIGNED FOR HELICOPTER ROTOR USE**

P. G. Wilby, N. Gregory, and V. G. Quincey London ARC 1973 37 p refs Supersedes ARC-31687; NPL-AERO-SR-036 (ARC-CP-1262; ARC-31687; NPL-AERO-SR-036) Avail: NTIS HC \$5.00; HMSO 60p; PHI \$2.55

Aerodynamic characteristics and ordinates are given for two modifications to the NACA 0012 profile with leading edge camber that were designed to produce reductions in wave drag in transonic flow. Analyses of hovering helicopter performance are given, to indicate the improvements that would follow from the adoption of either of these airfoils. Author (ESRO)

**N74-18667#** Admiralty Research Lab., Teddington (England). **BLADE-RATE FORCE FLUCTUATIONS OF A PROPELLER IN NON-UNIFORM FLOW**

M. T. Murray and J. Tubby Jun. 1973 56 p refs (ARL/M/P-33A; BR37674; P2/3.85) Avail: NTIS HC \$6.00

When a propeller rotates in a nonuniform flow field, unsteady propeller forces are generated at blade-rate frequency and its harmonics. A method of calculating these forces based upon two-dimensional unsteady aerofoil theory is described. A listing of a FORTRAN program to carry out these calculations is provided, together with a numerical example, and information

about using the program. This technique achieves adequate accuracy with minimal computing cost. Author (ESRO)

**N74-18668#** National Aeronautical Establishment, Ottawa (Ontario).

**AN EXPERIMENTAL ANALYSIS AND BUFFET INVESTIGATION OF THE SHOCKLESS LIFTING AIRFOIL NO. 1 [ANALYSE EXPERIMENTALE ET ETUDE DU TREMBLEMENT DU PROFIL PORTEUR NO. 1 SANS CHOC]**

J. J. Kacprzyński Aug. 1973 53 p refs (AD-772727; NAE-LR-569; NRC-13673) Avail: NTIS CSCL 01/1

Results of a second investigation of the shockless lifting airfoil no. 1, performed in the improved NAE high Reynolds number 15 inch x 60 inch two-dimensional test facility, are presented. Better agreement with theoretical design conditions is demonstrated. Off-design characteristics for several Mach numbers are analysed, particularly with regard to maximum lift, buffet and drag divergence. Author (GRA)

**N74-18671\*#** National Aeronautics and Space Administration, Flight Research Center, Edwards, Calif.

**INITIAL RESULTS FROM FLIGHT TESTING A LARGE, REMOTELY PILOTED AIRPLANE MODEL**

Euclid C. Holleman, comp. Mar. 1974 42 p refs (NASA-TM-X-56024) Avail: NTIS HC \$5.25 CSCL 01C

The first four flights of a remotely piloted airplane model showed that a flight envelope can be expanded rapidly and that hazardous flight tests can be conducted safely with good results. The flights also showed that aerodynamic data can be obtained quickly and effectively over a wide range of flight conditions, clear and useful impressions of handling and controllability of configurations can be obtained, and present computer and electronic technology provide the capability to close flight control loops on the ground, thus providing a new method of design and flight test for advanced aircraft. Author

**N74-18672\*#** General Electric Co., Evendale, Ohio. Aircraft Engine Group.

**IMPACT RESISTANCE OF CURRENT DESIGN COMPOSITE FAN BLADES TESTED UNDER SHORT-HAUL OPERATING CONDITIONS** Interim Report, Jul. 1972 - Jun. 1973

C. A. Steinhagen and C. T. Salemme Jul. 1973 60 p (Contract NAS3-16777) (NASA-CR-134533; R74AEG219) Avail: NTIS HC \$6.00 CSCL 01C

Boron/epoxy and graphite/epoxy composite blades were impacted in a rotating whirling facility with conditions closely simulating those which might be experienced by a STOL engine impacted with various foreign objects. The tip speed of the rotating blades was 800 feet per second. The blades were impacted with simulated birds, real birds, ice balls, and gravel. The results of composite blade impact tests were compared with a titanium blade tested under similar conditions. Neither composite material indicated a clear superiority over the other. Blades made from both composite materials showed more damage than the titanium blades. Author

**N74-18673\*#** Boeing Co., Seattle, Wash.

**CRUISE DRAG RESULTS FROM HIGH SPEED WIND TUNNEL TESTS OF NASA REFAN JT8D ENGINE NACELLES ON THE BOEING 727-200**

W. G. Easterbrook and R. B. Carlson Dec. 1973 42 p (Contract NAS3-17842) (NASA-CR-134546; D6-43099) Avail: NTIS HC \$5.25 CSCL 01C

High speed wind tunnel test results are presented showing the cruise drag effect of installing JT8D-109 Refan engines on a Boeing 727-200. Incremental drags of a refan center inlet and side nacelles are presented for several configuration variations. Static pressure distributions were obtained on the side nacelle strut and on the fuselage (above and below the strut). Oil flow photographs of selected configurations are also presented. In general the drag level of the refan installation is slightly better

than predicted prior to the test and the drag rise is favorable.

Author

**N74-18674\*#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**ANALYTICAL STUDY TO DEFINE A HELICOPTER STABILITY DERIVATIVE EXTRACTION METHOD, VOLUME 1 Final Report**

John A. Molusis May 1973 244 p refs  
(Contract NAS1-11613)

(NASA-CR-132371) Avail: NTIS HC \$15.25 CSDL 01B

A method is developed for extracting six degree-of-freedom stability and control derivatives from helicopter flight data. Different combinations of filtering and derivative estimate are investigated and used with a Bayesian approach for derivative identification. The combination of filtering and estimate found to yield the most accurate time response match to flight test data is determined and applied to CH-53A and CH-54B flight data. The method found to be most accurate consists of (1) filtering flight test data with a digital filter, followed by an extended Kalman filter (2) identifying a derivative estimate with a least square estimator, and (3) obtaining derivatives with the Bayesian derivative extraction method.

Author

**N74-18675\*#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**ANALYTICAL STUDY TO DEFINE A HELICOPTER STABILITY DERIVATIVE EXTRACTION METHOD, VOLUME 2 Final Report**

John A. Molusis May 1973 216 p  
(Contract NAS1-11613)

(NASA-CR-132372) Avail: NTIS HC \$14.00 CSDL 01B

The data generated during tests to determine helicopter stability derivatives are presented in the form of graphs. The data are based on CH-53A helicopters and CH-54B helicopters with various digital filters operating at various airspeeds. Curves are plotted for a time history comparison of identified derivative models against flight data for the helicopters at specific airspeeds and maneuvers.

P.N.F.

**N74-18676\*#** National Aeronautics and Space Administration. Langley Research Center, Langley Station, Va.

**CONTROL THEORY ANALYSIS OF A THREE-AXIS VTOL FLIGHT DIRECTOR M.S. Thesis - Pennsylvania State Univ.**

Frank R. Niessen Jun. 1971 85 p refs

(NASA-TM-X-69960) Avail: NTIS HC \$7.25 CSDL 01C

A control theory analysis of a VTOL flight director and the results of a fixed-based simulator evaluation of the flight-director commands are discussed. The VTOL configuration selected for this study is a helicopter-type VTOL which controls the direction of the thrust vector by means of vehicle-attitude changes and, furthermore, employs high-gain attitude stabilization. This configuration is the same as one which was simulated in actual instrument flight tests with a variable stability helicopter. Stability analyses are made for each of the flight-director commands, assuming a single input-output, multi-loop system model for each control axis. The analyses proceed from the inner-loops to the outer-loops, using an analytical pilot model selected on the basis of the innermost-loop dynamics. The time response of the analytical model of the system is primarily used to adjust system gains, while root locus plots are used to identify dominant modes and mode interactions.

Author

**N74-18677\*#** National Aeronautics and Space Administration. Ames Research Center, Moffett Field, Calif.

**PRELIMINARY PERFORMANCE ESTIMATES OF A HIGHLY MANEUVERABLE REMOTELY PILOTED VEHICLE**

Walter P. Nelms, Jr. and John A. Axelson Washington Feb. 1974 102 p refs

(NASA-TN-D-7551; A-5157) Avail: NTIS HC \$4.50 CSDL 01C

A computerized synthesis program has been used to assess the effects of various vehicle and mission parameters on the

performance of a highly maneuverable remotely piloted vehicle (RPV) for the air-to-air combat role. The configuration used in the study is a trapezoidal-wing and body concept, with forward-mounted stabilizing and control surfaces. The study mission consists of an outbound cruise, an acceleration phase, a series of subsonic and supersonic turns, and a return cruise. Performance is evaluated in terms of both the required vehicle weight to accomplish this mission and combat effectiveness as measured by turning and acceleration capability. The report describes the synthesis program, the mission, the vehicle, and the results of sensitivity and trade studies.

Author

**N74-18678\*#** Boeing Vertol Co., Philadelphia, Pa.

**ACOUSTICAL PROPERTIES OF A MODEL ROTOR IN NONAXIAL FLIGHT Final Report**

E. Hinterkeuser 15 Sep. 1973 66 p refs Sponsored in part by Army Air Mobility R and D Lab., Moffett Field, Calif.  
(Contract NAS2-5473)

(NASA-CR-114749; D210-10666-2) Avail: NTIS HC \$6.50 CSDL 01C

Wind tunnel measurements on model rotor blade loads and acoustical noise were correlated to a theoretical formulation of the rotational noise of a rotor in non-axial flight. Good correlation between theory and data was achieved using actual measured rotor blade pressure harmonic decay levels and lift, drag and radial force magnitudes. Both pressure and acoustic data exhibited considerable scatter in hover and low speed forward flight which resulted in a fairly wide latitude in the noise level prediction at higher harmonics.

Author

**N74-18679\*#** Lockheed-Georgia Co., Marietta.

**CORRELATION OF FULL-SCALE DRAG PREDICTIONS WITH FLIGHT MEASUREMENTS ON THE C-141A AIRCRAFT. PHASE 2: WIND TUNNEL TEST, ANALYSIS, AND PREDICTION TECHNIQUES. VOLUME 1: DRAG PREDICTIONS, WIND TUNNEL DATA ANALYSIS AND CORRELATION Final Report**

D. G. MacWilkinson, W. T. Blackerby, and J. H. Paterson Washington NASA Feb. 1974 166 p refs

(Contract NAS1-10045)

(NASA-CR-2333; LG73ER0058-Vol-1) Avail: NTIS HC \$5.00 CSDL 01C

The degree of cruise drag correlation on the C-141A aircraft is determined between predictions based on wind tunnel test data, and flight test results. An analysis of wind tunnel tests on a 0.0275 scale model at Reynolds number up to  $3.05 \times 10^6$  million/MAC is reported. Model support interference corrections are evaluated through a series of tests, and fully corrected model data are analyzed to provide details on model component interference factors. It is shown that predicted minimum profile drag for the complete configuration agrees within 0.75% of flight test data, using a wind tunnel extrapolation method based on flat plate skin friction and component shape factors. An alternative method of extrapolation, based on computed profile drag from a subsonic viscous theory, results in a prediction four percent lower than flight test data.

Author

**N74-18680\*#** Lockheed-Georgia Co., Marietta.

**CORRELATION OF FULL-SCALE DRAG PREDICTIONS WITH FLIGHT MEASUREMENTS ON THE C-141A AIRCRAFT: PHASE 2: WIND TUNNEL TESTS, ANALYSIS, AND PREDICTION TECHNIQUES. VOLUME 2: WIND TUNNEL TEST AND BASIC DATA Final Report**

D. G. MacWilkinson, W. T. Blackerby, and J. H. Paterson Washington NASA Feb. 1974 187 p refs

(Contract NAS1-10045)

(NASA-CR-2334; LG73ER0058-Vol-2) Avail: NTIS HC \$5.50 CSDL 01C

A research program has been conducted to determine the degree of cruise drag correlation on the C-141A aircraft between predictions based on wind tunnel test data, and flight test results. Information is presented on the wind tunnel test program and basic aerodynamic data on the C-141A wind-tunnel model used in the correlation studies.

Author

**N74-18681\*** Rockwell International Corp., Downey, Calif. Space Div.

**A METHODOLOGY FOR BOOST-GLIDE TRANSPORT TECHNOLOGY PLANNING Final Report**

E. M. Repic, G. A. Olson, and R. J. Milliken Washington NASA Feb. 1974 274 p ref  
(Contract NAS1-6024)

(NASA-CR-2346; SD-73-SA-0064) Avail: NTIS HC \$6.50 CSCL 01C

A systematic procedure is presented by which the relative economic value of technology factors affecting design, configuration, and operation of boost-glide transport can be evaluated. Use of the methodology results in identification of first-order economic gains potentially achievable by projected advances in each of the definable, hypersonic technologies. Starting with a baseline vehicle, the formulas, procedures and forms which are integral parts of this methodology are developed. A demonstration of the methodology is presented for one specific boost-glide system.

Author

**N74-18682#** Advisory Group for Aerospace Research and Development, Paris (France).

**AN OVERVIEW OF US ARMY HELICOPTER STRUCTURES RELIABILITY AND MAINTAINABILITY**

Thomas L. House (Army Air Mobility R and D Lab., Fort Eustis, Va.) Jan. 1974 19 p refs Presented at 36th Meeting of the Structures and Mater. Panel (SMP), Milan, 2-6 Apr. 1973

(AGARD-R-613) Avail: NTIS HC \$4.00

Approximately 25 percent of all U. S. Army helicopter failures and field maintenance man hours are related to structures. Externally induced damage is the primary cause of many failures, and it is the essential reliability and maintainability consideration in the selection of rotor blade and transparency designs. With the exception of rotor blades, most structural failures are normally considered as maintenance downtime sensitive as opposed to a cost problem. Greatly improved design and test documents coupled with lessons learned appear to be the most responsive approach to gaining significant structural improvements. Helicopter vibration reduction can produce a major reduction in secondary structural failure and maintenance rates.

Author

**N74-18683#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

**AIRCRAFT ACCIDENT REPORT: LOFTLEIDIR ICELANDIC AIRLINES, INCORPORATED, DOUGLAS DC-8-61, JOHN F. KENNEDY INTERNATIONAL AIRPORT, JAMAICA, NEW YORK, 23 JUNE 1973**

5 Dec. 1973 32 p

(NTSB-AAR-73-20) Avail: NTIS HC \$4.75

On June 23, 1973, a scheduled passenger and cargo flight, was involved in a landing accident after an instrument landing approach to runway 31R at the John F. Kennedy International Airport, Jamaica, New York. Of the 119 passengers and 9 crewmembers aboard the flight, 6 passengers and 2 stewardesses were injured seriously; there were no fatalities. The aircraft was damaged substantially. When the aircraft was about 40 feet above the runway, the ground spoilers were inadvertently deployed. The aircraft descended rapidly and hit the ground, tailfirst, 20 feet short of the displaced runway threshold. The probable cause of the accident was the first officer's inadvertent deployment of the ground spoilers in flight while he was attempting to arm the spoiler system. The captain's decision to delay arming of the spoilers until just before touchdown was a contributing factor, because the timing varied from normal procedures and required the crewmembers to act quickly, without time for corrective action.

Author

**N74-18684#** National Transportation Safety Board, Washington, D.C. Bureau of Aviation Safety.

**AIRCRAFT ACCIDENT REPORT: SKYWAYS INTERNATIONAL, INCORPORATED, DOUGLAS DC-7C, N296, NEAR THE MIAMI INTERNATIONAL AIRPORT, DADE COUNTY, FLORIDA, 21 JUNE 1973**

27 Feb. 1974 28 p refs

(NTSB-AAR-74-2) Avail: NTIS HC \$4.50

A Douglas DC-7C crashed into the Everglades, 8.9 nautical

miles north west of the Miami International Airport, on June 21, 1973. The accident occurred at 0426 e.d.t., about 6 minutes after the aircraft took off from runway 27L on the Miami International Airport. Before the aircraft crashed, fire damaged the left wing and the No. 1 engine. The aircraft was destroyed on impact. Three crewmembers, the only persons on board, were killed. The accident occurred during the hours of darkness and extremely heavy rain, wind, and lightning. There were no eyewitnesses. The probable cause of the accident was the loss of aircraft control, due either to turbulence or an in-flight fire, or both. Inability of the crew to establish timely radio communications with the departure controller was also a factor, because it delayed compliance with thunderstorm avoidance vectors.

Author

**N74-18685\*# Hydrospace-Challenger, Inc., San Diego, Calif. NOISE MEASUREMENTS AT STOCKTON AIRPORT OBTAINED DURING ENGINEERING EVALUATION OF TWO-SEGMENT APPROACHES IN A 727-222 AIRCRAFT**

Ray E. Glass and Carole S. Tanner 31 Aug. 1973 22 p  
(Contract NAS2-7369)

(NASA-CR-114689) Avail: NTIS HC \$4.25 CSCL 20A

The results of acoustic measurements made on a 727-222 aircraft during standard ILS and two-segment approaches are presented. The aircraft was equipped with a special purpose glide slope computer to provide the capability of making two-segment noise abatement approaches. For upper segment computations, the computer used barometric-corrected pressure altitude and the slant range to a DME transmitter which was collocated with the glide slope transmitter. The computer used the ILS glide slope deviation for lower segment computations. Additional measurements were made on 737 revenue aircraft using the Stockton Airport. The purpose of the acoustical portion of the test was to measure and identify the noise levels during the various approaches.

Author

**N74-18686\*# Hydrospace-Challenger, Inc., San Diego, Calif. NOISE MEASUREMENTS TAKEN AT LAX DURING OPERATIONAL EVALUATION OF TWO-SEGMENT APPROACHES IN A 727-200 AIRCRAFT**

Carole S. Tanner and Ray E. Glass 31 Aug. 1973 21 p  
(Contract NAS2-7369)

(NASA-CR-114690; HCI-TR-S-231) Avail: NTIS HC \$4.25 CSCL 20A

A series of seven noise measurements were made each day over a period of fifteen days. The first and last flights each day were made by a specially instrumented 727-200 aircraft being used to evaluate the operational effectiveness of two-segment noise abatement approaches in scheduled service. Noise measurements were made to determine the noise reduction benefits of the two-segment approaches.

Author

**N74-18687#** Kansas Univ. Center for Research, Inc., Lawrence, Flight Research Lab.

**SEPARATE SURFACE STABILITY AUGMENTATION DESIGN AND DEVELOPMENT Status Report**

D. J. Collins Nov. 1973 95 p refs

Avail: NTIS HC \$7.75

An approach to the mechanization of an attitude command control system for aircraft control is presented. The approach consisted of using control surfaces separate from the primary pilot's control surfaces. The anticipated advantages of the system are described. The design and development of the system are reported. The simulation and flight testing of the system are explained.

Author

**N74-18688\*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

**FLIGHT INVESTIGATION OF EFFECTS OF A FAN-IN-FIN YAW CONTROL CONCEPT ON HELICOPTER FLYING-QUALITY CHARACTERISTICS**

Henry L. Kelley and Thomas C. West Washington Apr. 1974 30 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Hampton, Va.

(NASA-TN-D-7452; L8923) Avail: NTIS HC \$3.25 CSCL 01C

Flight-test results which describe flying-quality factors related to the fan-in-fin yaw control concept as utilized on a pre-production version of a European helicopter are presented. Design compromises to be considered with this concept are also presented. The large, fixed vertical fin associated with the fan-in-fin system was helpful in maneuvering flight, but introduced several flying-quality problems when combined with the fan. Author

**N74-18689#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

**GUST LOADS ON COMET AIRCRAFT**

I. W. Kaynes London ARC 1973 64 p refs Supersedes RAE-TR-71165; ARC-33682 (ARC-CP-1247; RAE-TR-71165; ARC-33682) Avail: NTIS HC \$6.25; HMSO 85p; PHI \$3.55

Counting accelerometer have been used to record normal acceleration on BOAC Comet 4 and RAF Comet 4C aircraft for flight distances of 910,000 km and 388,000 km respectively. Two Comet 4 aircraft carried instruments and a significant difference is found between the frequencies of gusts observed on each. Revised data for the BOAC Comet 1 and RAF Comet 2 are presented and comparison of the four fleets shows that loads were recorded more often on the civil airline operations. The effect of the cloud warning radar carried by only the later aircraft is studied. Author (ESRO)

**N74-18690#** Royal Aircraft Establishment, Bedford (England). Aerodynamics Dept.

**SOME OBSERVATIONS ON MANOEUVRE STABILITY AND LONGITUDINAL CONTROL**

W. J. Pinsker London ARC 1973 22 p refs Supersedes RAE-TR-72068; ARC-34020 (ARC-R/M-373C; RAE-TR-72068; ARC-34020) Avail: NTIS HC \$4.25; HMSO 85p; PHI \$3.55

Some of the more important practical implications to pilot's control, flight test analysis, and stability augmentor performance of classical longitudinal stability theory are discussed. The distinction between turns and pull-ups is reemphasized and the differences quantified. Angular momentum of the engines is shown to make a contribution which can be significant with STOL aircraft, being destabilizing in turns in one direction but stabilizing in the opposite direction. Author (ESRO)

**N74-18691#** General Dynamics/Fort Worth, Tex. Convair Aerospace Div.

**A CONCEPTUAL DEFINITION STUDY FOR A DIGITAL AVIONICS INFORMATION SYSTEM: APPROACH 1, VOLUME 1 Final Report, Feb. - Jul. 1973**

William C. Booton, Dan H. Daggett, H. O. Gaffin, C. D. Campbell, W. B. Anderson, H. W. Blackmon, L. C. Klos, J. P. Catching, W. J. Yousey, and G. E. Hinds Wright-Patterson AFB, Ohio AFAL Oct. 1973 49 p 3 Vol. (Contract F33615-73-C-1244) (AD-771736; AFAL-TR-73-300-Vol-1) Avail: NTIS CSCL 01/3

The report contains the results of a study to conceptually define the Digital Avionics Information System (DAIS). A predesign analysis provided the Air Force with sufficient information to define the best design approach for the development of the four DAIS core elements. Core elements are identified as (1) a microprogrammable processor system, (2) a multiplex/interface system, (3) a modular software system, and (4) an integrated control and display system. In addition, the requirements for a digital flight control system were identified; and associated DAIS processing, control and display, and distribution requirements necessary for function implementation were determined. (Modified author abstract) GRA

**N74-18692#** General Dynamics/Fort Worth, Tex. Convair Aerospace Div.

**A CONCEPTUAL DEFINITION STUDY FOR A DIGITAL AVIONICS INFORMATION SYSTEM: APPROACH 1,**

**VOLUME 2 Final Report, Feb. - Jul. 1973**

William C. Booton, Dan H. Daggett, H. O. Gaffin, C. D. Campbell, W. B. Anderson, H. W. Blackmon, L. C. Klos, J. P. Catching, W. J. Yousey, and G. E. Hinds Wright-Patterson AFB, Ohio AFAL Oct. 1973 332 p refs 3 Vol. (Contract F33615-73-C-1244) (AD-771755; AFAL-TR-73-300-Vol-2) Avail: NTIS CSCL 01/3

Contents: Functional requirements; Breakpoints and partitioning; Information management requirements. GRA

**N74-18693#** Lockheed-California Co., Burbank.

**ICE PROTECTION INVESTIGATION FOR ADVANCED ROTARY-WING AIRCRAFT Final Report**

J. B. Werner Aug. 1973 392 p refs (Contract DAAJ02-72-C-0054) (AD-771182/3GA; LR-25327-10; USAAMRDL-TR-73-38) Avail: NTIS HC \$8.00 CSCL 01/3

Ice protection requirements for advanced rotary wing aircraft were studied. The study included investigations into the hazards of flying through ice, probability of icing, vehicle ice accretion rates, current ice protection system designs, operational limitations of current helicopters, and advanced deicing concepts. (Modified author abstract) GRA

**N74-18694#** Bureau of Mines, Pittsburgh, Pa. Mining and Safety Research Center.

**FIRE AND EXPLOSION MANUAL FOR AIRCRAFT ACCIDENT INVESTIGATORS Final Summary Report, 1 Jul. 1972 - 31 Jul. 1973**

Joseph M. Kuchta Aug. 1973 136 p refs (Contract F33615-72-M-5008) (AD-771191/4GA; PMSRC-4193; AFAPL-TR-73-74) Avail: NTIS HC \$4.50 CSCL 01/2

The manual was prepared at the request of the Air Force to provide aircraft accident investigators with compilations of various safety data and with suitable guidelines for investigating aircraft fires or explosions. Sections are included on investigative procedures, physical properties of materials, ignitability, and flammability characteristics of flammable fluids or solids, damage analysis of fires or explosions, and the evaluation of protective measures. Compilations of selected data for fuels, lubricants, hydraulic fluids, explosives, and other materials of interest are given in the appendix for quick reference. Definitions and theory necessary to the application of these data are included in the appropriate sections of the manual. (Modified author abstract) GRA

**N74-18695#** Army Aviation Systems Command, St. Louis, Mo.

**MAJOR ITEM SPECIAL STUDY (MISS), AH-1G MAIN TRANSMISSION ASSY, UNIVERSAL Interim Report, Jan. 1964 - Jul. 1972**

Dec. 1973 32 p (AD-772983; USAAVSCOM-TR-73-30) Avail: NTIS CSCL 01/3

Major Item Special Study (MISS) reports are performed on DA Form 2410 reportable components. These are time change items and certain condition change items selected because of high cost or need for intensive management. Basically, the MISS reports are concerned with analyzing reported removal data presented in the Major Item Removal Frequency (MIRF) report. The failure modes reported for each removal are examined and grouped into categories which are intended to clarify the intent of the data reporting. From this data, removal distributions can be plotted and an MTR (mean time to removal) can be calculated. The MISS reports then investigate possible cost savings based on total elimination of selected failure modes. These modes are chosen because of the percentage of failures they represent and/or because they appear to be feasible Product Improvement Program (PIP) areas. Author (GRA)

**N74-18696#** Boeing Vertol Co., Philadelphia, Pa.

**STUDY OF ADVANCED STRUCTURAL CONCEPTS FOR**

**FUSELAGE Final Technical Report**

Sidney C. Swatton Oct. 1973 189 p refs  
(Contract DAAJ02-72-C-0056; DA Proj. 1F1-62208-A-170)  
(AD-772708; D210-10683; USAAMRDL-TR-73-69) Avail:  
NTIS CSCL 01/3

The report presents the results of a study conducted to develop advanced structural concepts and the application of fiber-reinforced composite materials for the Cobra AH-1G helicopter tail section. This study comprised the following tasks: (1) analysis of existing AH-1G metal tail section to determine areas having highest potential structural improvement, (2) development and preliminary design studies of various advanced structural concepts and selection of three concepts for preliminary design trade-off study, (3) determination of parameters affecting cost effectiveness and performance of composite fuselage structure, (4) sensitivity analysis for reducing tail-section life-cycle costs, and (5) development of a math model for life-cycle costs and performance of composite fuselage, and utilization of model to recommend the optimum design. (Modified author abstract)

GRA

**N74-18697#** Rockwell International Corp., Los Angeles Calif. Aircraft Div.

**STOL TACTICAL AIRCRAFT INVESTIGATION: EXTERNALLY BLOWN FLAP. VOLUME 1: CONFIGURATION DEFINITION Final Report, 10 Jun. 1971 - 10 Dec. 1972**

Herschel G. Owens, Roy S. Kaneshiro, Dirk J. Renselaer, and Don W. Schlundt Apr. 1973 371 p refs  
(Contract F33615-71-C-1760; AF Proj. 643A)  
(AD-772738; AFFDL-TR-73-20-Vol-1) Avail: NTIS CSCL 01/1

The basic objective of the report is to provide a broader technology base to support the development of a medium STOL Transport (MST) airplane. The work is limited to the application of the externally blown flap (EBF) powered lift concept. The technology of EBF STOL aircraft is investigated through analytical studies, wind tunnel testing, flight simulator testing, and design trade studies. The results obtained include development of methods for the estimation of the aerodynamic characteristics of an EBF configuration, STOL performance estimation methods, safety margins for takeoff and landing, wind tunnel investigation of the effects of varying EBF system geometry parameters, configuration definition to meet MST requirements, trade data on performance and configuration requirement variations, flight control system mechanization trade data, handling qualities characteristics, piloting procedures, and effects of applying an air cushion landing system to the MST. (Modified author abstract)

GRA

**N74-18698#** Aeronautical Systems Div., Wright-Patterson AFB, Ohio.

**A LIMITED ANALYSIS OF AN F-4C AIRCRAFT WITH A HIGH-GAIN CONTROL AUGMENTATION SYSTEM AND COMPARISON WITH FLIGHT TEST DATA**

Richard A. Kogler May 1973 118 p refs  
(AD-772673; ASD-TR-73-21) Avail: NTIS CSCL 01/3

A high-gain control augmentation system was designed by the Bendix Corporation to allow the pilot of a fighter aircraft to command the  $C^*$  parameter through the longitudinal control stick. This system was installed in an F-4C aircraft and flight tested at the Air Force Flight Test Center. A theoretical analysis of the control augmentation system and airframe combination was performed for nine selected flight conditions. The results showed that the CAL thumbprint, MIL-F-8785 B(ASG) and  $C^*$  flying qualities criteria do not predict longitudinal flying qualities consistent with qualitative pilot ratings from flight test. Pilot comments indicated significant improvement in the longitudinal flying qualities of the F-4C with the  $C^*$  command control augmentation system over the production aircraft. (Modified author abstract)

GRA

**N74-18699#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**TO ASSIST THE SPORTSMAN-HELICOPTER PILOT IN BLIND FLIGHT**

F. Prokopenko 11 Dec. 1973 17 p Transl. into ENGLISH from Krylya Rodiny (USSR), no. 3. Mar. 1969 p 23-25  
(AD-772650; FTD-HT-23-481-74) Avail: NTIS CSCL 01/2

The report proposes recommendations for mastering instrument flight in helicopters.

GRA

**N74-18700#** Boeing Vertol Co., Philadelphia, Pa.

**CH-47A DESIGN AND OPERATIONAL FLIGHT LOADS STUDY Final Report**

A. Herskovitz and H. Steinmann Nov. 1973 52 p refs  
(Contract DAAJ02-72-C-0087; DA Proj. 1F1-62204-AA-82)  
(AD-772949; D210-10579-1; USAAMRDL-TR-73-40) Avail:  
NTIS CSCL 01/3

The report describes a study made to evaluate the adequacy of current structural design criteria for future cargo- and transport-type helicopters based on the design, development, and operational use of the CH-47A Chinook helicopter. It was concluded that current structural design criteria are adequate to insure structural safety. Specifications for procurement of new helicopters should be modified to provide the most realistic mission description possible for fatigue design, with the objective of simplifying the design task. While analyzing CH-47A operational data, several deficiencies were identified in the data acquisition and analysis process. (Modified author abstract)

GRA

**N74-18701#** Army Missile Command, Redstone Arsenal, Ala. Aeroballistics Directorate.

**A PROGRAM FOR COMPUTING THE PRESSURE DISTRIBUTION AND AERODYNAMIC COEFFICIENTS FOR CAMBERED THIN SUPERSONIC WINGS OF ARBITRARY PLANFORM WITH SUBSONIC LEADING EDGES**

Bruce L. VanBuren 5 Aug. 1973 70 p refs  
(DA Proj. 1M2-62303-A-214)

(AD-772952; RD-73-24) Avail: NTIS CSCL 01/1

The computer solution to the linearized potential flow equations which gives a reasonably accurate description of the pressure distribution for thin cambered supersonic wings with subsonic leading edges is presented. The program will compute the aerodynamic coefficients associated with the pressure distribution such that comparison can be made of the aerodynamic characteristics between a flat wing and a cambered wing at small angles of attack.

Author (GRA)

**N74-18702#** Army Aeromedical Research Lab., Fort Rucker, Ala.

**PARACHUTE ESCAPE FROM HELICOPTERS**

William P. Chane Aug. 1973 14 p refs  
(DA Proj. 3A0-62110-A-819)  
(AD-772970; USAARL-74-4) Avail: NTIS CSCL 01/2

Experimental evidence shows that a parachutist experiences no major difficulty in achieving vertical and horizontal separation from an autorotating helicopter. At high rates of descent, there is a 0.5 - 0.75 second delay after exit before expected separation begins.

Author (GRA)

**N74-18703#** Delaware Univ., Newark.

**OPEN AND CLOSED LOOP STABILITY OF HINGELESS ROTOR HELICOPTER AIR AND GROUND RESONANCE**

Maurice I. Young, David J. Bailey, and Murray S. Hirschbein 1974 34 p refs  
(Grant DA-ARO(D)-31-124-71-G112)

(AD-772826; AROD-9549-9-E) Avail: NTIS CSCL 01/3

The air and ground resonance instabilities of hingeless rotor helicopters are examined on a relatively broad parametric basis including the effects of blade tuning, virtual hinge locations, and blade hysteresis damping, as well as size and scale effects in the gross weight range from 5,000 to 48,000 pounds. A special case of a 72,000 pound helicopter air resonance instability is also included. (Modified author abstract)

GRA

**N74-18704#** Rockwell International Corp., Los Angeles Calif. Aircraft Div.

**STOL TACTICAL AIRCRAFT INVESTIGATION-EXTERNALLY BLOWN FLAP. VOLUME 4: ANALYSIS OF WIND TUNNEL**

**DATA Final Report, 10 Jun. 1971 - 10 Dec. 1972**

Patrick P. Papp, Ralph A. Quam, and Gerald A. Freeman Apr. 1973 395 p refs

(Contract F33615-71-C-1760; AF Proj. 643A)

(AD-772774; AFFDL-TR-73-20-Vol-4) Avail: NTIS CSCL 01/1

The basic objective of the report is to provide a broader technology base to support the development of a medium STOL Transport (MST) airplane. The work is limited to the application of the externally blown flap (EBF) powered lift concept. From an overall assessment of study results, it is concluded that the EBF concept provides a practical means of obtaining STOL performance for an MST with relatively low risk. (Modified author abstract) GRA

**N74-18705# Rochester Univ., N.Y.****ANALYTICAL INVESTIGATION OF THE AERODYNAMIC STABILITY OF HELICAL VORTICES SHED FROM A HOVERING ROTOR Final Report**

Bharat P. Gupta and Robert G. Loewy Oct. 1973 150 p refs

(Contract DAAJ02-72-C-0042; DA Proj. 1F1-62204-AA-42) (AD-773026; USAAMRDL-TR-73-84) Avail: NTIS CSCL 01/1

A small-perturbation stability analysis of a doubly infinite array of interdigitated, right circular helical vortices has been formulated. This array corresponds to the vortices trailed from the tips of the blades of a helicopter rotor or propeller in static thrust or axial flight condition and at great distance from the plane of rotation of the blades. The analysis makes use of the Biot-Savart law of induction and the Vorticity Transport Theorem. The singularities in the Biot-Savart integration for self-induction have been eliminated by substituting approximate functions. Near-singular behavior in other integrals has been minimized by adding and subtracting functions with similar near-singular behavior and which have exact, closed-form integrals. (Modified author abstract) GRA

**N74-18706# AiResearch Mfg. Co., Los Angeles, Calif. ADVANCED TORQUE MEASUREMENT SYSTEM Final Technical Report**

J.-D. Chang and Joseph Kukul Aug. 1973 205 p refs

(Contract DAAJ02-72-C-0044; DA Proj. 1F1-62205-A-119) (AD-773021; USAAMRDL-TR-73-54; Rept-73-9343) Avail: NTIS CSCL 01/3

The report encompasses the preliminary research of application requirements, error sources, and special considerations; design of the advanced torque measurement system; fabrication of the advanced torque measurement system; and laboratory testing of the advanced torque measurement system under various conditions. Program results indicate that such a high-accuracy and high-environmental-tolerance torque measurement system for helicopter power-plant diagnostic purpose is both hardware implementable and economically feasible. (Modified author abstract) GRA

**N74-18707# Boeing Vertol Co., Philadelphia, Pa.****ANALYSIS OF CRITERIA FOR ON-CONDITION MAINTENANCE FOR HELICOPTER TRANSMISSIONS Final Report**

J. J. Dougherty, III and S. J. Blewitt Sep. 1973 379 p refs

(Contract DAAJ02-72-C-0068; DA Proj. 1F1-62205-A-119) (AD-773024; D210-10593-1; USAAMRDL-TR-73-58) Avail: NTIS CSCL 01/3

The report presents the results of a study which develops a rational approach for evaluating the potential of a helicopter transmission for on-condition operation. Integral to this study is the presentation of the mathematical relationship between component operating time and component hazard rate. It is postulated that the component hazard function is the crux of an on-condition analysis. Various methods of determining hazard functions were evaluated, and a conclusion is presented defining the most powerful of these techniques. An evaluation of the impact of on-condition transmission operation upon reliability, safety, availability, maintainability, mission reliability, and cost was developed. The conclusions of the study present the criteria

for evaluating the potential of a newly designed or existing helicopter transmission for on-condition operation. (Modified author abstract) GRA

**N74-18708# Boeing Vertol Co., Philadelphia, Pa.****DESIGN, FABRICATION, AND FLIGHT TEST OF THE ACTIVE ARM EXTERNAL LOAD STABILIZATION SYSTEM FOR CARGO HANDLING HELICOPTERS Final Technical Report**

J. H. Smith, G. M. Allen, and D. Vensel Sep. 1973 173 p refs

(Contract DAAJ02-72-C-0046; DA Proj. 1F1-63209-DB-33) (AD-773025; D210-10638-1; USAAMRDL-TR-73-73) Avail: NTIS CSCL 01/3

The report discusses the analysis, design, fabrication, and flight test of an experimental active arm external load stabilization system. The purpose of this effort was to achieve the load damping required for helicopter instrument flight rules operations (load modal damping ratio greater than 0.25) without imposing excessive power requirements on the helicopter subsystems or unsafe conditions on the helicopter. Flight test of the system on the Boeing Model 347 helicopter demonstrated adequate load dynamic stability characteristics and elimination of pilot-induced oscillation throughout the test flight envelope. (Modified author abstract) GRA

**N74-18709# Systems Associates, Inc., Long Beach, Calif. US ARMY HELICOPTER HYDRAULIC SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATION. VOLUME 1: DOCUMENT DEFICIENCY ANALYSIS Final Report**

James L. Huffman Sep. 1973 228 p refs 2 Vol.

(Contract DAAJ02-73-C-0013; DA Proj. 1F1-62205-A-119) (AD-773022; SAI-R73-005-Vol-1; USAAMRDL-TR-73-63A-Vol-1) Avail: NTIS CSCL 13/7

The investigation was performed in order to identify deficiencies in military specifications and standards concerning hydraulic systems in U.S. Army helicopters. The three areas of concern that impact on helicopter reliability and maintainability are: design requirements, qualification test requirements, procedures and practices, and quality assurance provisions and requirements. Documents were collected from DOD sources, supplemented by information from manufacturers: drawings, and Army maintenance manuals. They were analyzed for application to the documentation tree and whether they required major revision, minor revision, deletion, or rewrite. Areas which lacked design documentation were identified for new documentation requirements. (Modified author abstract) GRA

**N74-18710# Systems Associates, Inc., Long Beach, Calif. US ARMY HELICOPTER HYDRAULIC SYSTEM RELIABILITY AND MAINTAINABILITY INVESTIGATION. VOLUME 2: SUPPLEMENTAL DESIGN GUIDE Final Report**

James L. Huffman Sep. 1973 209 p refs 2 Vol.

(Contract DAAJ02-73-C-0013; DA Proj. 1F1-62205-A-119) (AD-773023; SAI-R73-005-Vol-2; USAAMRDL-TR-73-63B-Vol-2) Avail: NTIS CSCL 13/7

The report is a result of the investigation performed in Volume 1, Document Deficiency Analysis which identifies deficiencies in military specifications and standards that may impact the reliability and maintainability of U.S. Army helicopters. The report provides supplementary information for each deficient document relating to design requirements, qualification testing, and quality assurance. The supplementary information to offset the most prevalent deficiencies addressed helicopter mission design requirements which relate to environmental conditions, reliability and maintainability programs, and safety. Environmental testing and reliability and maintainability requirements were also addressed. (Modified author abstract) GRA

**N74-18711# United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.****CH-53 A FLEXIBLE FRAME VIBRATION ANALYSIS/TEST CORRELATION**

Irwin J. Keningsberg 28 Mar. 1973 248 p



(Contract N00019-72-C-0411)

(AD-772569; SER-651195) Avail: NTIS CSCL 01/3

The Sikorsky Finite Element Airframe Vibration Analysis (Fran/Vibration Analysis) has been found to correlate well with data taken in shake tests of the CH-53A. The frequencies of fundamental fuselage bending and transmission modes were predicted by the Fran/Vibration Analyses to an average accuracy of three percent. In addition, the mode shapes were defined accurately. The modeling techniques and analysis used in the study can be applied during helicopter design and during evaluation of growth versions of current aircraft. These techniques, in combination with an accurate definition of the vehicle's structural characteristics, will enable accurate prediction of all transmission and fuselage modes for a vehicle without a cargo ramp. (Modified author abstract) GRA

**N74-18712#** United Aircraft Corp., Stratford, Conn. Sikorsky Aircraft Div.

**CH-54 B MAIN GEARBOX THERMAL MAPPING PROGRAM Final Report**

Donald F. Wilson Nov. 1973 106 p refs

(Contract DAAJ02-72-C-0072; DA Proj. 1G1-62208-AA-72) (AD-772664; SER-64375; USAAMRDL-TR-73-79) Avail: NTIS CSCL 01/3

The report contains the procedures and results of a thermal mapping program conducted on the CH-54B main gearbox. The gearbox was analyzed to determine heat paths and heat sources and was instrumented to measure housing and dynamic component temperatures as well as thermal growth. Thermal maps of the gearbox were made at oil-outlet temperatures of 242F, 280F, 325F, and 372F. MIL-L-7808G oil was used for all tests. The temperatures measured indicated that the present method of analyzing the gearbox is adequate. Thermal growth measurements indicated that the handbook values for thermal coefficient of expansion are adequate for analysis. Recommendations are made for additional research required to develop a self-contained, more survivable gearbox design. Author (GRA)

**N74-18713#** Fiber Science, Inc., Gardena, Calif.

**UH-1D FILAMENT-WOUND TUBULAR-REINFORCED ROTOR BLADE Final Report**

David Wall, Dale Abildskov, and Larry Ashton Oct. 1973 115 p

(Contract DAAJ02-72-C-0013; DA Proj. 1F1-62208-A-170) (AD-772947; USAAMRDL-TR-73-61) Avail: NTIS CSCL 01/3

The results of engineering design, fabrication and testing of filament-wound tubular-reinforced composite main rotor blades for the UH-1D helicopter are reported. Three blades were fabricated using wet winding, two using principally S-glass roving/epoxy and one using principally PRD-49 roving. In the course of the program, a design concept for making a highly redundant root-end attachment was developed and the fabrication feasibility was proven. The ability to calculate the structural characteristics was verified within the testing and fabrication tolerances. Author (GRA)

**N74-18714#** Rochester Univ., N.Y. Center for Visual Science. **VISUAL ELEMENTS IN FLIGHT SIMULATION**

John Lott Brown Dec. 1973 74 p refs

(Contract N00014-67-A-0398-0007)

(AD-772586; TR-73-2) Avail: NTIS CSCL 01/3

The goal of airlines is to reduce to an absolute minimum the amount of time spent in aircraft for training. Simulators are cheaper and safer to operate than aircraft, although some maneuvers still must be learned in actual flight. Some aspects of aircraft control depend upon an exterior view from the aircraft of the outside visual world, but providing good specifications for just how to simulate the external visual world is far from simple. There is currently no solid scientific basis for cataloging visual cues with respect to their importance in aircraft control. The report constitutes a summary of the information gathered by the Working Group to remedy this situation and recommendations arising out of its deliberations. GRA

**N74-18715#** Rockwell International Corp., Columbus, Ohio. Aircraft Div.

**CONTROL-BY-WIRE ACTUATOR MODEL DEVELOPMENT FOR AFCAS Final Technical Report, 2 Jan. 1973 - 10 Jan. 1974**

J. Demarchi, N. Gianforcaro, R. Haning, R. Hupp, F. Malikowski, G. Maroscher, and B. Mathena Jan. 1974 84 p refs

(Contract N62269-73-C-0405)

(AD-772588; NR73H-107) Avail: NTIS CSCL 01/4

The report describes the design and fabrication of an engineering model, 8000 psi, control-by-wire, modular configured, aircraft type hydraulic servo actuator for the Navy sponsored AFCAS development program. The modular elements could be used to build up either a dual tandem, dual parallel, or simple servo actuator. The tandem and parallel configurations were controlled by two synchronized, single stage, spool/sleeve type flow control valves designed to operate at 8000 psi using MIL-H-83282 fluid. Each valve spool was coupled directly to and driven by a force motor with rare earth cobalt samarium permanent magnets and four armature coils for redundancy. A dual parallel linear variable differential transfer position feedback transducer was mounted inside the actuator piston rod. Steady-state performance tests were conducted on one spool/sleeve assembly and force motor. Author (GRA)

**N74-18716#** Bell Helicopter Co., Fort Worth, Tex.

**COLD-WEATHER FLIGHT TESTS OF AN OH-58 HELICOPTER EQUIPPED WITH AN ELASTOMERIC-BEARING MAIN ROTOR**

C. H. Fagan Aug. 1973 38 p refs

(Contract DAAH02-73-C-0024; DA Proj. 1F1-63209-DB-38) (AD-772935; BHC-TR-299-099-644; USAAMRDL-TR-73-70)

Avail: NTIS CSCL 01/3

The report contains the results of a flight test program conducted to investigate the characteristics of a main rotor equipped with elastomeric bearings operating at low temperatures. The helicopter used was an OH-58A, and the main rotor tested had elastomeric bearings in the pitch-change and flapping axes. The tests were conducted at Fort Wainwright, Alaska, and operation at temperatures of 48F, 5F, -9F, -13F, -29F, and -52F was evaluated. Normal rotor control was obtained down to temperatures of -13F. At lower temperatures, elastomer stiffening causes increased control system loads, which limit operation. (Modified author abstract) GRA

**N74-18717#** Army Aviation Systems Command, St. Louis, Mo.

**MAJOR ITEM SPECIAL STUDY (MISS), CH-47A ENGINE Interim Report, Jan. 1964 - Jul. 1973**

Dec. 1973 23 p

(AD-772978; USAAVSCOM-TR-73-29) Avail: NTIS CSCL 01/3

The report is designed to illustrate cost savings which would result from specific efforts in the areas of product improvement in quality and design. For the purpose of this study the cost savings produced in the area of product improvement are based on total elimination of a certain failure mode or modes. Appropriate modes are chosen because of their proportion of the total removals or their proportion in combination with other similar modes. These eliminated removals are then assumed to follow the distribution of the remaining removal modes. The actual cost savings are determined from the increase in the mean time to removal based on the new removal distributions. GRA

**N74-18718#** Army Air Mobility Research and Development Lab., Fort Eustis, Va.

**THE EFFECTS OF SAND PARTICLES ON SMALL, INTRICATE MECHANICAL COMPONENTS Final Report**

Donald R. Artis, Jr. Oct. 1973 151 p refs

(DA Proj. 1F1-62205-A-119)

(AD-772977; USAAMRDL-TR-73-93) Avail: NTIS CSCL 01/3

The report presents the results of a series of tests conducted to investigate the failure mode of binding caused by sand particles

in small, intricate mechanical components. These tests were prompted by the large number of failures of components where the suspected mode of failure was binding caused by sand ingestion. The armament system circuit breaker of the AH-1G helicopter was selected as the device to be tested. (Modified author abstract) GRA

**N74-18719#** Naval Postgraduate School, Monterey, Calif.  
**HYDRAULIC RAM SHOCK WAVE AND CAVITATION EFFECTS ON AIRCRAFT FUEL CELL SURVIVABILITY** M.S. Thesis

Dwight Patrick Holm Sep. 1973 84 p refs  
 (AD-772744) Avail: NTIS CSCL 10/2

Hydraulic ram is the dynamic loading of fuel tanks when impacted by bullets or other projectiles. During impact and penetration of the fuel cell, intense pressure waves are generated by the projectile. A ballistic range was built and experimental testing was conducted to study hydraulic ram phenomena. A 0.22 caliber rifle was used to accelerate projectiles at velocities in the range of 0.38 km/sec into a transparent, water filled tank. Shape and intensity of the shock wave pressure pulse induced as a result of projectile impact were determined using a dual shadowgraph system. Peak pressures were found to be as high as 4,500 x kg/sq cm. The rate of energy transfer to the fluid by the projectile was determined experimentally and compared with analytical predictions. A characteristic time was defined establishing the separation point between the shock and cavity phases of hydraulic ram. Author (GRA)

**N74-18813#** Lockheed-California Co., Burbank, Materials Lab.  
**GALVANIC CORROSION EFFECTS ASSOCIATED WITH GRAPHITE COMPOSITES/METAL JOINTS**

G. R. Johnston, J. S. Fritzen, and K. E. Weber Nov. 1973 32 p refs  
 (LR-26088; Rept-21-3744-4228) Avail: NTIS HC \$4.75

The corrosion reactions that occur when graphite composites are joined to aircraft structural metals have been investigated. The fundamental electrochemical mechanisms responsible for the galvanic degradation process were elucidated. Investigations were also performed to characterize the corrosion behavior of actual composite-to-metal joints subjected to salt spray environments. In addition, studies of the moisture permeability characteristics of graphite composites are in progress. Details of these various investigations and the experimental results obtained to date are presented. Author

**N74-18833#** Advisory Group for Aerospace Research and Development, Paris (France).

**AGARD FLIGHT TEST INSTRUMENTATION SERIES: VOLUME 5: MAGNETIC RECORDING OF FLIGHT TEST DATA**

G. E. Bennett, W. D. Mace, ed., and A. Pool, ed. Feb. 1974 80 p refs  
 (AGARDograph-160-Vol-5; AGARD-AG-160-Vol-5) Avail: NTIS HC \$7.00

An assessment of the general requirement for a flight test data acquisition system is followed with a general discussion of the complete system. The more important individual functions of the system are those most intimately involved in determining the performance of the system and its efficiency in acquiring the data. In the case of the recording aspects emphasis is placed on the basic recording process, its capabilities and its problems, and on the techniques necessary to overcome its shortcomings. Basic design principles of airborne tape transports and the characteristics of write/read heads and magnetic tape are also discussed. Author

**N74-18842\*#** Stanford Research Inst., Menlo Park, Calif.  
**DESIGN OF A FAULT TOLERANT AIRBORNE DIGITAL COMPUTER. VOLUME 2: COMPUTATIONAL REQUIREMENTS AND TECHNOLOGY** Final Report

R. S. Ratner, E. B. Shapiro, H. M. Zeidler, S. E. Wahlstrom, C.

B. Clark, and J. Goldberg Oct. 1973 151 p refs  
 (Contract NAS1-10920)

(NASA-CR-132253) Avail: NTIS HC \$10.75 CSCL 09B

This final report summarizes the work on the design of a fault tolerant digital computer for aircraft. Volume 2 is composed of two parts. Part 1 is concerned with the computational requirements associated with an advanced commercial aircraft. Part 2 reviews the technology that will be available for the implementation of the computer in the 1975-1985 period. With regard to the computation task 26 computations have been categorized according to computational load, memory requirements, criticality, permitted down-time, and the need to save data in order to effect a roll-back. The technology part stresses the impact of large scale integration (LSI) on the realization of logic and memory. Also considered was module interconnection possibilities so as to minimize fault propagation. Author

**N74-18895\*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.  
**THE EFFECT OF WIND TUNNEL WALL INTERFERENCE ON THE PERFORMANCE OF A FAN-IN-WING VTOL MODEL**

Harry H. Heyson Washington Feb. 1974 232 p refs  
 (NASA-TN-D-7518; L-9202) Avail: NTIS HC \$6.00 CSCL 14B

A fan-in-wing model with a 1.07-meter span was tested in seven different test sections with cross-sectional areas ranging from 2.2 sq meters to 265 sq meters. The data from the different test sections are compared both with and without correction for wall interference. The results demonstrate that extreme care must be used in interpreting uncorrected VTOL data since the wall interference may be so large as to invalidate even trends in the data. The wall interference is particularly large at the tail, a result which is in agreement with recently published comparisons of flight and large scale wind tunnel data for a propeller-driven deflected-slipstream configuration. The data verify the wall-interference theory even under conditions of extreme interference. A method yields reasonable estimates for the onset of Rae's minimum-speed limit. The rules for choosing model sizes to produce negligible wall effects are considerably in error and permit the use of excessively large models. Author

**N74-18904** Cincinnati Univ., Ohio.  
**THE AERO/ACOUSTIC RESPONSE OF FINITE CHORD BLADE ROWS TO CIRCUMFERENTIAL INLET FLOW DISTORTION IN AN UNSTEADY COMPRESSIBLE FLUID** Ph.D. Thesis

C. Thomas Savell 1973 137 p  
 Avail: Univ. Microfilms Order No. 74-100

The problem is considered of non-uniform inlet flow transfer through a compressor of a jet engine. Two separate techniques are used to approximate the unsteady flow in the rotor. The first technique is the semi-actuator disc analysis which models the blade cascade as one dimensional wave guides. This method permits an extension from an isolated rotor to a compressor stage. Two parametric studies on the response of a loaded rotor to inlet distortions are done for a single rotor operating at off design conditions and a number of rotors operating at their design points. The second technique is based on unsteady thin airfoil theory. It is a more refined analysis capable of describing the effect of cascade solidity on the distortion transfer. The model consists of representing each blade by a moving doublet filament of finite length immersed in a compressible stream containing a velocity distortion. The study is limited to an unloaded, flat plate, rotor. Dissert. Abstr.

**N74-18917\*#** Kanner (Leo) Associates, Redwood City, Calif.  
**RESULTS OF THE COMBINED APPLICATION OF BOUNDARY LAYER AND PROFILE THEORY**

Richard Eppler Washington NASA Mar. 1974 38 p refs  
 Transl. into ENGLISH from Z. Flugwiss (Brunswick), v. 8, no. 9, Sep. 1960 p 247-260  
 (Contract NASw-2481)  
 (NASA-TT-F-15416) Avail: NTIS HC \$5.00 CSCL 20D

Applied results of combined boundary layer and profile theory show that it is possible to determine profiles with fixed characteristics of pressure distribution by means of which extensive boundary layer calculations can be carried out; series of profiles can be studied systematically and determination of profiles, analogous to procedure in wind tunnels, is possible. Theoretical possibilities are explained with examples. Author

**N74-18920#** Cambridge Univ. (England). Dept. of Engineering.

**FINITE ELEMENT ANALYSIS OF THE FLOW THROUGH A CASCADE OF AEROFOILS**

David S. Thompson 1973 48 p refs  
(CUED/A-Turbo/TR-45) Avail: NTIS HC \$5.50

Finite element methods are applied to steady incompressible flow in two dimensional cascades of compressor blades. A triangular element is used, with a cubic interpolation for velocity potential or stream function, and the velocities at the nodes. An isoparametric version of this element is described for use at curved boundaries. The results are compared with exact solutions, experimental measurements and other numerical methods.

Author

**N74-18939#** Southern Methodist Univ., Dallas, Tex. Thermal and Fluid Sciences Center.

**THE SEPARATING TURBULENT BOUNDARY LAYER: AN EXPERIMENTAL STUDY OF AN AIRFOIL TYPE** Technical Report, 1 Oct. 1971 - 1 Jul. 1973

James H. Strickland and Roger L. Simpson Aug. 1973 241 p  
(Grant DA-ARO(D)-31-124-72-G31)  
(AD-771170/8GA; WT-2; AROD-10092-2-E) Avail: NTIS HC \$5.75 CSCL 20/4

Experimental measurements in a separating turbulent boundary layer were made. Mean velocity and turbulence intensity profiles were obtained using hot film and laser anemometry. Mean and fluctuating wall shear stress distributions were obtained using flush mounted hot film sensors. The bursting frequency at various streamwise locations was also obtained from the wall hot film sensors. The intermittency was obtained utilizing a photo-electric technique. The celerities of various eddy structures were obtained by using a double hot film probe. (Modified author abstract) GRA

**N74-18949#** Georgia Inst. for Research, Atlanta. School of Aerospace Engineering.

**POTENTIAL FLOW STUDIES OF LIFT-FAN INFLOW INTERFERENCE PHENOMENA** Final Report, 1 Feb. 1972 - 31 Jan. 1973

J. C. Wu, R. Sigman, J. Hubbart, and H. McMahon Oct. 1973 119 p refs  
(Contract F33615-72-C-1086)  
(AD-773194; ARL-73-0132) Avail: NTIS CSCL 20/4

The report presents results of a study of the lift-fan inlet problem and includes a comprehensive survey of the existing experimental data and analytical methods, an analysis of the potential flow, and a boundary layer analysis for lift-fan inlets. Numerical solutions are presented for potential flows associated with inlet ducts set in an infinite plane with and without a centerbody simulating the hub of the fan. The effects of the cross flow to mean inlet velocity ratio, of the inlet and hub lip radii to duct width ratio, of the inclination of the duct axis to the plane, and of the position of the hub relative to the plane on the flow in and near the inlet ducts are discussed utilizing a two dimensional potential flow analysis. (Modified author abstract) GRA

**N74-19053#** Stockholm Univ. (Sweden). Inst. of Meteorology. **GAS-PHASE NITROGEN AND METHANE CHEMISTRY IN THE ATMOSPHERE**

Paul Crutzen 29 Jun. 1972 24 p refs Presented at the Summer Advanced Study Inst., Phys. and Chem. of Upper Atmospheres, Orleans-La Source, France, 31 Jul. - 11 Aug. 1972 Submitted for publication

(AP-10) Avail: NTIS HC \$4.25

In order to justify the possible role of large scale supersonic transport operation, the gas phase chemistry of the troposphere was investigated. Reactions included the production and destruction of ozone, sources and sinks for the NO<sub>x</sub>, the odd H reactions, and the oxidation of methane. Distributions of trace gases in the stratosphere were tabulated. It is concluded that many problems of both chemical and meteorological nature must be solved before any reliable predictions can be made regarding ozone reduction due to the effects of large scale supersonic transport operation. ESRO

**N74-19107#** Sperry Rand Corp., Phoenix, Ariz. Flight Systems Div.

**ANGLE OF ATTACK COMPUTATION SYSTEM** Final Report

Duane B. Freeman Sep. 1973 60 p ref  
(Contract F33615-71-C-1280)  
(AD-771183/1GA; Rept-71-0353-00-00; AFFDL-TR-73-89)  
Avail: NTIS HC \$3.50 CSCL 01/4

The results of a program to evaluate computing angle-of-attack by inference using air data, aircraft acceleration, surface positions and stored aerodynamic data are presented. The computation was implemented in an analog type airborne computer and evaluated in a U.S. Air Force RF-4C aircraft. The mathematical relationships selected for calculating the aircraft angle-of-attack, the system implementation and the flight test program are described herein. The flight test data is reduced, and computed angle-of-attack is compared to the output of an externally mounted vane. As indicated by the results, computed angle-of-attack is feasible and accurate with normally available onboard aircraft sensors. Author (GRA)

**N74-19144#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

**A DEVICE FOR SPREADING SMALL GRAIN BAIT LURE** A. V. Barabash 30 Nov. 1973 6 p Transl. into ENGLISH from Zashchi. Rast. (Moscow), no. 11, 1968 p 21  
(AD-772053; FTD-HT-23-588-74) Avail: NTIS CSCL 06/6

Considering the advantages of a twin-boom spreader for small grain bait, the All-Union Institute of Agriculture and Special Application of Civil Aviation in 1965 developed a new device for an AN-2 Aircraft. It insures a discharge of 0.5 to 2.0 kg/ha, and has an attachment for the reliable cut-off of baitspreading when turning off the apparatus. The aerial spreading is accomplished through twin booms; 6-7 m long, with a 23 m spacing between their outlets, which corresponds to a swath 50 m wide. GRA

**N74-19184#** Boeing Commercial Airplane Co., Seattle, Wash. **PROGRAM TO IMPROVE THE FRACTURE TOUGHNESS AND FATIGUE RESISTANCE OF ALUMINUM SHEET AND PLATE FOR AIRFRAME APPLICATIONS** Final Technical Report, 1 Jul. 1972 - 1 Jul. 1973

Michael V. Hyatt Sep. 1973 214 p refs  
(Contract F33615-72-C-1649; AF Proj. 7351)  
(AD-772736; D6-60183; AFML-TR-73-224) Avail: NTIS CSCL 11/6

Mechanical, fracture, smooth and notched fatigue, fatigue crack growth rate, and exfoliation corrosion tests were conducted to evaluate the effects of the various thermomechanical treatments. For comparison purposes, data were obtained on the commercial alloys 2024-T3, 7075-T6, 7475-T61, 7475-T761. In addition, a few TMTs on the commercial 7475 alloy were evaluated. (Modified author abstract) GRA

**N74-19271#** Stanford Research Inst., Menlo Park, Calif. **PAPERS PRESENTED AT THE LIGHTNING AND STATIC ELECTRICITY CONFERENCE (1972). STRUCTURE OF LIGHTNING NOISE - ESPECIALLY ABOVE HF. TRIGGERED LIGHTNING AND ITS APPLICATION TO ROCKETS AND AIRCRAFT**

N. Cianos, G. N. Oetzel, and Edward T. Pierce Dec. 1973 20 p refs

(Contract N00014-71-C-0106; SRI Proj. 4454)  
(AD-771464; SN-20) Avail: NTIS CSCL 04/1

The document contains two reports; one which summarizes the characteristics of the radiation fields due to lightning and the other discusses lightning initiated by high-rise buildings, aircraft or rockets. GRA

**N74-19281#** National Aeronautical Establishment, Ottawa (Ontario).

**MODIFICATION OF V/STOL INSTRUMENT APPROACH GEOMETRY AS A MEANS OF COMPENSATING FOR ALONG-TRACK WIND EFFECTS**

W. S. Hindson and D. G. Gould Jan. 1974 29 p  
(NRC-13842; LR-573) Avail: NTIS HC \$4.50

The influence of wind on the low speed approach and landing operation of V/STOL aircraft is investigated. The problems which may require specific solutions for V/STOL aircraft are discussed. A method to allow for significant along-track wind effects, including shears, is proposed. The method is based on modifying the approach geometry relative to the earth according to the ambient wind condition. Author

**N74-19282\*#** National Aeronautics and Space Administration, Langley Research Center, Langley Station, Va.

**DEVELOPMENT AND FLIGHT TESTS OF A GYRO-LESS WING LEVELER AND DIRECTIONAL AUTOPILOT**

H. Douglas Garner and Harold E. Poole Washington Apr. 1974 53 p refs  
(NASA-TN-D-7460; L-9229) Avail: NTIS HC \$3.75 CSCL 01B

A gyro-less wing leveler and directional autopilot were developed and flight tested in a single-engine light airplane. The primary purpose of the project was to develop a simple, reliable, low-cost stability augmentation and autopilot system for light aircraft. The wing leveler used a fluidic inertial rate sensor, electronic signal processing circuitry, and vacuum operated servos. A strap-down magnetic heading reference of simple design provided the wing leveler with directional autopilot capability. Flight tests indicated that the performance of the gyro-less wing leveler was equal to that of a commercial wing leveler using a gyroscopic rate sensor. Drift-free, long-term, heading-hold capability of the magnetic heading reference was demonstrated. Author

**N74-19283#** Royal Aircraft Establishment, Farnborough (England).

**APPLICATION OF MONTE CARLO METHODS TO ESTIMATION OF COLLISION RISKS ASSOCIATED WITH ATC SEPARATION STANDARDS**

D. E. Lloyd and P. P. Scott Jun. 1973 46 p refs  
(RAE-TR-73104; BR37072) Avail: NTIS HC \$5.50

This risk can be estimated in several ways, one of which is to assign each indeterminate quantity a probability distribution and use Monte Carlo methods to combine these, giving a distribution of risk. An example of these methods, to the safety assessment of a proposed 90 mile lateral separation standard for North Atlantic jet aircraft is also presented. Author (ESRO)

**N74-19401\*#** General Electric Co., Cincinnati, Ohio. Aircraft Engine Group.

**QUIET ENGINE PROGRAM: TURBINE NOISE SUPPRESSION. VOLUME 2: TREATMENT SELECTION, INSTALLATION, AND TEST RESULTS**

A. Clemons, H. Hehmann, and K. Radecki Dec. 1973 282 p refs  
(Contract NAS3-12430)  
(NASA-CR-134586; R73AEG443-Vol-2) Avail: NTIS HC \$17.25 CSCL 21E

Acoustic treatment was developed for jet engine turbine noise suppression. Acoustic impedance and duct transmission loss measurements were made for various suppression systems. An environmental compatibility study on several material types having suppression characteristics is presented. Two sets of engine hardware were designed and are described along with engine test results which include probe, farfield, near field, and acoustic

directional array data. Comparisons of the expected and the measured suppression levels are given as well as a discussion of test results and design techniques. Author

**N74-19404#** Advisory Group for Aerospace Research and Development, Paris (France).

**V/STOL PROPULSION SYSTEMS Technical Evaluation Report**

H. Grieb (Motoren-und Turbinen-Union Muenchen GmbH) and N. A. Mitchell (Rolls Royce, Ltd.) Jan. 1974 12 p refs  
(AGARD-AR-64) Avail: NTIS HC \$4.00

The proceedings of a conference on propulsion systems for V/STOL aircraft are presented. The subjects discussed are: (1) propulsion system and airframe integration, (2) V/STOL propulsion system components, (3) environmental effects, and (4) V/STOL propulsion system operating experience. Author

**N74-19405\*#** National Aeronautics and Space Administration, Lewis Research Center, Cleveland, Ohio.

**A SIMPLIFIED LIFE-CYCLE COST COMPARISON OF VARIOUS ENGINES FOR SMALL HELICOPTER USE**

Kestutis C. Civinskas and Laurence M. Fishbach Feb. 1974 29 p refs Prepared in cooperation with Army Air Mobility R and D Lab., Cleveland, Ohio  
(NASA-TM-X-71517; E-7908) Avail: NTIS HC \$4.50 CSCL 21A

A ten-year, life-cycle cost comparison is made of the following engines for small helicopter use: (1) simple turboshaft; (2) regenerative turboshaft; (3) compression-ignition reciprocator; (4) spark-ignited rotary; and (5) spark-ignited reciprocator. Based on a simplified analysis and somewhat approximate data, the simple turboshaft engine apparently has the lowest costs for mission times up to just under 2 hours. At 2 hours and above, the regenerative turboshaft appears promising. The reciprocating and rotary engines are less attractive, requiring from 10 percent to 80 percent more aircraft to have the same total payload capability as a given number of turbine powered craft. A nomogram was developed for estimating total costs of engines not covered in this study. Author

**N74-19407#** AiResearch Mfg. Co., Phoenix, Ariz.  
**PNEUMOMECHANICAL CRITICAL SPEED CONTROL FOR GAS TURBINE ENGINE SHAFTS** Final Report, Oct. 1972 - Sep. 1973

R. A. Collins and D. E. Heuer Nov. 1973 98 p refs  
(Contract F33615-72-C-2152)  
(AD-772823; AFAPL-TR-73-102; Rept-73-310366) Avail: NTIS CSCL 21/5

The purpose of the program was to evaluate and demonstrate the feasibility of utilizing gas-lubricated foil bearings to resist high shaft excursions as the shaft advances through bending criticals and to determine the extent a shaft critical can be moved (increased) through use of these bearings. The program to determine the loads imposed on the midspan foil bearing as the rotor advances through two predominantly bending critical speeds. The program resulted in a successful demonstration of the foil bearing as a device to diminish shaft excursion and shift the frequency of critical shaft speeds. (Modified author abstract) GRA

**N74-19411#** Boeing Vertol Co., Philadelphia, Pa.  
**INVESTIGATION AND ANALYSIS OF RELIABILITY AND MAINTAINABILITY PROBLEMS ASSOCIATED WITH ARMY AIRCRAFT ENGINES** Final Report

K. G. Rummel and H. J. M. Smith Aug. 1973 222 p refs  
(Contract DAAJ02-71-C-0055; DA Proj. 1F1-62205-A-119)  
(AD-772950; D210-10571-1; USAAMRDL-TR-73-28) Avail: NTIS CSCL 21/5

The reliability and maintainability problems associated with gas turbine engines currently operational with the U.S. military services were examined in the report. A broad spectrum of turboshaft and turboprop engines in U.S. Army, Navy and Marine helicopters and fixed-wing aircraft was examined. The study concentrated on the detailed R and M experience of the

T53, T55, T58, T64, T73 and T74, although quantitative R-M data is provided on other gas turbine engines in military and commercial service. (Modified author abstract) GRA

**N74-19413#** Air Force Systems Command, Wright-Patterson AFB, Ohio. Foreign Technology Div.

#### BY-PASS ENGINES

G. Predtechenskii 30 Nov. 1973 14 p Transl. into ENGLISH from Grazhdanskaya Aviats. (USSR), no. 6, Jun. 1973 p 24-25 (AD-772723; FTD-HT-23-537-74) Avail: NTIS CSCL 21/5

The report describes the design and performance of Soviet designed jet aircraft bypass engines. GRA

**N74-19544\*#** Boeing Aerospace Co., Seattle, Wash.  
**CYCLIC-STRESS ANALYSIS OF NOTCHES FOR SUPER-SONIC TRANSPORT CONDITIONS**

Feb. 1974 51 p refs

(Contract NAS1-12484)

(NASA-CR-132387) Avail: NTIS HC \$5.75 CSCL 20K

The feasibility of using the finite element method to account for the effects of cyclic load and temperature on local stresses and strains at a notch was demonstrated. The behavior of a notched titanium panel was studied under variable loads and temperatures representative of flight conditions for the lower wing surface of a Supersonic Transport (SST). The analysis was performed with the use of the BOPACE finite-element computer program which provides capability to determine high temperature and large viscoplastic effects caused by cyclic thermal and mechanical loads. The analysis involves the development of the finite-element model as well as determination of the structural behavior of the notched panel. Results are presented for twelve SST flights comprised of five different load-temperature cycles. The results show the approach is feasible, but material response to cyclic loads, temperatures, and hold times requires improved understanding to allow proper modeling of the material. Author

**N74-19550#** Advisory Group for Aerospace Research and Development, Paris (France).

#### ACOUSTIC FATIGUE DESIGN DATA, PART 3

A. G. R. Thomson (Eng. Sci. Data Unit Ltd.) and R. E. Lambert (Eng. Sci. Data Unit Ltd.) Dec. 1973 62 p refs (AGARDograph-162-Pt-3; AGARD-AG-162-Pt-3) Avail: NTIS HC \$6.25

The design criteria for aircraft structural elements to reduce the effects of acoustic fatigue are discussed. The subjects presented are: (1) endurance of titanium and titanium alloy structural elements subjected to simulated acoustic loading, (2) damping in acoustically excited structures, (3) reference frequency of panel with flexible stiffeners, and (4) estimation of stress in skin panels with flexible stiffeners subjected to random acoustic loading. Author

**N74-19563#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

#### STRUCTURAL REPRESENTATION IN AEROELASTIC CALCULATIONS

L. T. Niblett London ARC 1973 12 p refs

(ARC-R/M-3729) Avail: NTIS HC \$4.00; HMSO 50p; PHI \$2.15

The practicability of allowing approximately for the higher-frequency normal modes of a structure by using a residual flexibility matrix is examined. A better method of approximation which retains the concept of residual flexibility is discussed, and arguments in favour of it are given. Author (ESRO)

**N74-19564#** Bristol Univ. (England).

#### KRON'S METHOD: AN ALGORITHM FOR THE EIGEN-VALUE ANALYSIS OF LARGE-SCALE STRUCTURAL SYSTEMS

A. Simpson London ARC 1973 16 p refs Supersedes ARC-34098

(ARC-R/M-3733; ARC-34098) Avail: NTIS HC \$4.00; HMSO 60p; PHI \$2.55

The Kron eigenvalue procedure is established by the application of Hamilton's principle to a constrained primitive Lagrangian comprising the characteristics of the various sub-systems into which a composite system is torn to facilitate analysis. The computational merits of the method are outlined, particularly in relation to a scanning algorithm derived from a procedure developed by Wittrick and Williams. Author (ESRO)

**N74-19565#** Royal Aircraft Establishment, Farnborough (England). Structures Dept.

#### VIBRATION AMPLITUDES PRODUCED IN ST. DAVID'S CATHEDRAL BY CONCORDE SONIC BANGS

F. L. Hunt London ARC 1973 31 p refs Supersedes RAE-TR-71121; ARC-33123

(ARC-R/M-3736; RAE-TR-71121; ARC-33123) Avail: NTIS HC \$4.75; HMSO £ 1.10; PHI \$4.30

At St. David's Cathedral, structural vibrations produced by a number of Concorde sonic bangs were measured and compared with the vibration produced by the structures normal environment. The results show that bang produced amplitudes are not very much greater than the environmental vibration amplitudes. It is unlikely that continued exposure of the Cathedral to sonic bangs would result in appreciably accelerated structural decay. Author (ESRO)

**N74-19567#** Royal Aircraft Establishment, Farnborough (England).

#### A THEORETICAL STUDY OF INACCURACIES ARISING FROM THE REPRESENTATION OF A CONTINUOUS GUST SPECTRUM BY A PROGRAMME OF DISCRETE LOADS IN FATIGUE TESTS

A. M. Stagg Aug. 1973 66 p refs

(BR37134; RAE-TR-73085) Avail: NTIS HC \$6.50

A theoretical analysis has been made of the inaccuracies involved in the representation of a continuous distribution of aircraft gust loads by a program of loads at a few discrete levels to be applied to a fatigue test specimen. These inaccuracies arise through the failure of the simplified test load program to inflict fatigue damage at the correct rate in those parts of the specimen where the stress per unit acceleration has a value other than that for which the test loading was derived. Three severities of gust spectrum and two families of S-N curve were used in the fatigue damage calculations which were based on Miner's hypothesis. The number of discrete load levels in the derived program varied from one to seven. Two main conclusions are reached, namely that the more load levels used in the test representation the better is the accuracy of the simulation and that the chosen levels should encompass the most damaging level of load in the continuous service spectrum. It is believed that the trends noted can be related to other forms of continuous spectrum and other types of S-N curve. Author (ESRO)

**N74-19623#** Joint Publications Research Service, Arlington, Va.

#### SCIENCE AND TRANSPORT

I. Ya. Aksenov 14 Mar. 1974 51 p refs Transl. into ENGLISH of the booklet "Nauka i Transport" Moscow, Znaniye, 1974 64 p

(JPRS-61482) Avail: NTIS HC \$5.75

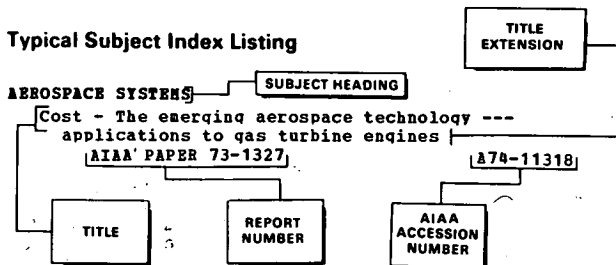
Data on the association of transportation to science and engineering are discussed. The basic scientific and technical problems of transportation along with suggestions for future improvements are outlined. Author

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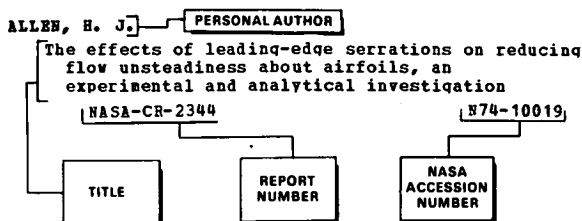
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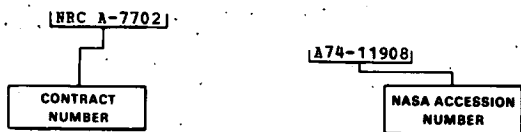
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